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Introduction

Scientific and Technical Aerospace Reports (STAR) is an online information resource listing citations and abstracts of NASA and world wide aerospace-related STI. Updated biweekly, *STAR* highlights the most recent additions to the NASA STI Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related Research & Development (R&D) results.

STAR subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

STAR includes citations to Research & Development (R&D) results reported in:

- NASA, NASA contractor, and NASA grantee reports
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The NASA Scientific and Technical Information (STI) Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

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Each citation in *STAR* indicates a 'Source of Availability'. When CASI is indicated, the user can order this information directly from CASI using the [STI Online Order Form](#) or contact help@sti.nasa.gov or telephone the CASI Help Desk at 301-621-0390. Before ordering you may access price code tables for STI [documents](#) and [videos](#). When information is not available from CASI, the source of the information is indicated when known.

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The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at <http://www.uspto.gov/patft/>.

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SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

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02 AERODYNAMICS

Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery. For related information, see also 34 Fluid Mechanics and Heat Transfer.

20030004845 NASA Ames Research Center, Moffett Field, CA USA

Subsonic Longitudinal Aerodynamic Characteristics of Disks with Elliptic Cross Sections and Thickness-Diameter Ratios from 0.225 to 0.425

Demele, Fred A., NASA Ames Research Center, USA; Brownson, Jack J., NASA Ames Research Center, USA; April 1961; 25p; In English

Report No.(s): NASA-TN-D-788; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

General interest in manned space flight has provided a stimulus for the investigation of shapes which appear to be attractive for application to re-entry vehicles. Such vehicles can be classed as either nonlifting or lifting. Nonlifting types, such as used in Project Mercury, have certain advantages which include structural simplicity, no requirement for an elaborate flight-control system, ease of mating with the booster, and short exposure times to high heating rates during entry. Advantages of lifting types, by comparison, include lower peak heating rates and decelerations, the possibility for a conventional horizontal landing, and the ability to maneuver, thus providing control over longitudinal and lateral range and a wider entry corridor on return from planetary or lunar missions. A lifting shape which appears attractive in terms of the considerations is a thick disk. At high attitudes, the weight to drag ratio is low and the radius of curvature of the surface exposed to the airstream is large, a combination of parameters which results in reduced convective heating rates. The low-speed lift-drag ratios associated with this type of shape appear sufficiently high to permit a conventional horizontal landing. The investigation reported herein was undertaken to assess the effects of thickness on the aerodynamic characteristics of disk shapes suitable for lifting re-entry into the earth's atmosphere and potentially capable of conventional horizontal landing. The models had elliptic cross sections which varied in thickness from 0.225 to 0.425 diameter. The tests were conducted in the Ames 12-Foot Pressure Wind Tunnel over a Mach number range from 0.25 to 0.90 at a Reynolds number of 3.3×10^6 (exp 6) and at Reynolds numbers to 16×10^6 (exp 6) at a Mach number of 0.25. Tests on similar shapes have been conducted at subsonic, transonic, and supersonic speeds and the results have been presented.

Author

Aerodynamic Characteristics; Subsonic Speed; Thickness Ratio; Longitudinal Stability; Wind Tunnel Tests; Ellipticity; Disks (Shapes)

20030004848 NASA Ames Research Center, Moffett Field, CA USA

A Flight Study of the Dynamic Stability of a Tilting-Rotor Convertiplane

Quigley, Hervey C., NASA Ames Research Center, USA; Koenig, David G., NASA Ames Research Center, USA; April 1961; 10p; In English

Report No.(s): NASA-TN-D-778; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A flight investigation was conducted to determine the effect of blade flapping on the stability and control of the XV-3 convertiplane in cruise and high speed flight. The results of the study indicated that the inplane forces on the prop-rotors due to the blade flapping associated with airplane angular rates were in a direction to produce negative damping moments on the airplane.

As a result of these inplane forces, the damping ratio of the longitudinal short period and lateral-directional oscillations approached zero at the maximum airspeed of the test airplane.

Author

High Speed; Tilting Rotors; XV-3 Aircraft; Wind Tunnel Tests; Rotor Aerodynamics; Dynamic Stability

20030005099 Taitech, Inc., Cleveland, OH USA

Near Field Trailing Edge Tone Noise Computation *Final Report*

Loh, Ching Y., Taitech, Inc., USA; December 2002; 14p; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS3-97186; RTOP 708-90-43

Report No.(s): NASA/CR-2002-212013; NAS 1.26:212013; E-13703; AIAA Paper 2003-0365; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Blunt trailing edges in a flow often generate tone noise due to wall-jet shear layer and vortex shedding. In this paper, the space-time conservation element (CE/SE) method is employed to numerically study the near-field noise of blunt trailing edges. Two typical cases, namely, flow past a circular cylinder (aeolian noise problem) and flow past a flat plate of finite thickness are considered. The computed frequencies compare well with experimental data. For the aeolian noise problem, comparisons with the results of other numerical approaches are also presented.

Author

Computation; Aeroacoustics; Aerodynamic Noise; Blunt Trailing Edges; Flow Noise; Near Fields

20030005441 NASA Langley Research Center, Hampton, VA USA

Drag Prediction for the DLR-F4 Wing/Body using OVERFLOW and CFL3D on an Overset Mesh

Vassberg, John C., Boeing Phantom Works, USA; Buning, Pieter G., NASA Langley Research Center, USA; Rumsey, Christopher L., NASA Langley Research Center, USA; [2002]; 24p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0840; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper reviews the importance of numerical drag prediction in an aircraft design environment. A chronicle of collaborations between the authors and colleagues is discussed. This retrospective provides a road-map which illustrates some of the actions taken in the past seven years in pursuit of accurate drag prediction. The advances made possible through these collaborations have changed the manner in which business is conducted during the design of all-new aircraft. The subject of this study is the DLR-F4 wing/body transonic model. Specifically, the work conducted herein was in support of the 1st CFD Drag Prediction Workshop, which was held in conjunction with the 19th Applied Aerodynamics Conference in Anaheim, CA during June, 2001. Comprehensive sets of OVERFLOW simulations were independently performed by several users on a variety of computational platforms. CFL3D was used on a limited basis for additional comparison on the same overset mesh. Drag polars based on this database were constructed with a CFD-to-Test correction applied and compared with test data from three facilities. These comparisons show that the predicted drag polars fall inside the scatter band of the test data, at least for pre-buffet conditions. This places the corrected drag levels within 1% of the averaged experimental values. At the design point, the OVERFLOW and CFL3D drag predictions are within 1-2% of each other. In addition, drag-rise characteristics and a boundary of drag-divergence Mach number are presented.

Author

Aerodynamic Drag; Aircraft Design; Body-Wing Configurations; Computational Grids

20030005447 NASA Langley Research Center, Hampton, VA USA

Experimental Hypersonic Aerodynamic Characteristics of the 2001 Mars Surveyor Precision Lander with Flap

Horvath, Thomas J., NASA Langley Research Center, USA; OConnell, Tod F., NASA Langley Research Center, USA; Cheatwood, F. McNeil, NASA Langley Research Center, USA; Prabhu, Ramadas K., Lockheed Martin Engineering and Sciences Co., USA; Alter, Stephen J., NASA Langley Research Center, USA; [2002]; 18p; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4408; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Aerodynamic wind-tunnel screening tests were conducted on a 0.029 scale model of a proposed Mars Surveyor 2001 Precision Lander (70 deg half angle spherically blunted cone with a conical afterbody). The primary experimental objective was

to determine the effectiveness of a single flap to trim the vehicle at incidence during a lifting hypersonic planetary entry. The laminar force and moment data, presented in the form of coefficients, and shock patterns from schlieren photography were obtained in the NASA Langley Aerothermodynamic Laboratory for post-normal shock Reynolds numbers (based on forebody diameter) ranging from 2,637 to 92,350, angles of attack ranging from 0 to 23 degrees at 0 and 2 degree sideslip, and normal-shock density ratios of 5 and 12. Based upon the proposed entry trajectory of the 2001 Lander, the blunt body heavy gas tests in CF, simulate a Mach number of approximately 12 based upon a normal shock density ratio of 12 in flight at Mars. The results from this experimental study suggest that when traditional means of providing aerodynamic trim for this class of planetary entry vehicle are not possible (e.g. offset c.g.), a single flap can provide similar aerodynamic performance. An assessment of blunt body aerodynamic effects attributed to a real gas were obtained by synergistic testing in Mach 6 ideal-air at a comparable Reynolds number. From an aerodynamic perspective, an appropriately sized flap was found to provide sufficient trim capability at the desired L/D for precision landing. Inviscid hypersonic flow computations using an unstructured grid were made to provide a quick assessment of the Lander aerodynamics. Navier-Stokes computational predictions were found to be in very good agreement with experimental measurement.

Author

Aerodynamic Characteristics; Aerothermodynamics; Hypersonic Flow; Inviscid Flow

20030005452 NASA Johnson Space Center, Houston, TX USA

Aerocapture Guidance Algorithm Comparison Campaign

Rousseau, Stephane, Centre National d'Etudes Spatiales, France; Perot, Etienne, Centre National d'Etudes Spatiales, France; Graves, Claude, NASA Johnson Space Center, USA; Masciarelli, James P., NASA Johnson Space Center, USA; Queen, Eric, NASA Langley Research Center, USA; [2002]; 10p; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4822; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The aerocapture is a promising technique for the future human interplanetary missions. The Mars Sample Return was initially based on an insertion by aerocapture. A CNES orbiter Mars Premier was developed to demonstrate this concept. Mainly due to budget constraints, the aerocapture was cancelled for the French orbiter. A lot of studies were achieved during the three last years to develop and test different guidance algorithms (APC, EC, TPC, NPC). This work was shared between CNES and NASA, with a fruitful joint working group. To finish this study an evaluation campaign has been performed to test the different algorithms. The objective was to assess the robustness, accuracy, capability to limit the load, and the complexity of each algorithm. A simulation campaign has been specified and performed by CNES, with a similar activity on the NASA side to confirm the CNES results. This evaluation has demonstrated that the numerical guidance principal is not competitive compared to the analytical concepts. All the other algorithms are well adapted to guaranty the success of the aerocapture. The TPC appears to be the more robust, the APC the more accurate, and the EC appears to be a good compromise.

Author

Aerocapture; Spacecraft Guidance; Algorithms

20030005486 NASA Langley Research Center, Hampton, VA USA

Wind Tunnel Measurements of Shuttle Orbiter Global Heating with Comparisons to Flight

Berry, Scott A., NASA Langley Research Center, USA; Merski, N. Ronald, NASA Langley Research Center, USA; Blanchard, Robert C., George Washington Univ., USA; [2002]; 14p; In English; AIAA Atmospheric Flight Mechanics Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4701; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

An aerothermodynamic database of global heating images was acquired of the Shuttle Orbiter in the NASA Langley Research Center 20-Inch Mach 6 Air Tunnel. These results were obtained for comparison to the global infrared images of the Orbiter in flight from the infrared sensing aeroheating flight experiment (ISAFE). The most recent ISAFE results from STS-103, consisted of port side images, at hypersonic conditions, of the surface features that result from the strake vortex scrubbing along the side of the vehicle. The wind tunnel results were obtained with the phosphor thermography system, which also provides global information and thus is ideally suited for comparison to the global flight results. The aerothermodynamic database includes both windward and port side heating images of the Orbiter for a range of angles of attack (20 to 40 deg), freestream unit Reynolds number (1×10^6)/ft to 8×10^6 /ft, body flap deflections (0, 5, and 10 deg), speed brake deflections (0 and 45 deg), as

well as with boundary layer trips for forced transition to turbulence heating results. Sample global wind tunnel heat transfer images were extrapolated to flight conditions for comparison to Orbiter flight data. A windward laminar case for an angle of attack of 40 deg was extrapolated to Mach 11.6 flight conditions for comparison to STS-2 flight thermocouple results. A portside wind tunnel image for an angle of attack of 25 deg was extrapolated for Mach 5 flight conditions for comparison to STS-103 global surface temperatures. The comparisons showed excellent qualitative agreement, however the extrapolated wind tunnel results over-predicted the flight surface temperatures on the order of 5% on the windward surface and slightly higher on the portside.

Author

Space Shuttle Orbiters; Wind Tunnel Tests; Infrared Imagery; Hypersonic Speed; Thermography; Aerodynamic Heating

20030005490 NASA Langley Research Center, Hampton, VA USA

Active Control of Separation from the Slat Shoulder of a Supercritical Airfoil

Pack, LaTunia G., NASA Langley Research Center, USA; Schaeffler, Norman W., NASA Langley Research Center, USA; Yao, Chung-Sheng, NASA Langley Research Center, USA; Seifert, Avi, Tel-Aviv Univ., Ramat-Aviv, Israel; [2002]; 17p; In English; 1st Flow Control Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-3156; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Active flow control in the form of zero-mass-flux excitation was applied at the slat shoulder of a simplified high-lift airfoil to delay flow separation. The NASA Energy Efficient Transport (EET) supercritical airfoil was equipped with a 15% chord simply hinged leading edge slat and a 25% chord simply hinged trailing edge flap. The cruise configuration data was successfully reproduced, repeating previous experiments. The effects of flap and slat deflection angles on the performance of the airfoil integral parameters were quantified. Detailed flow features were measured as well, in an attempt to identify optimal actuator placement. The measurements included: steady and unsteady model and tunnel wall pressures, wake surveys, arrays of surface hot-films, flow visualization and Particle Image Velocimetry (PIV). High frequency periodic excitation was applied to delay the occurrence of slat stall and improve the maximum lift by 10 to 15%. Low frequency amplitude modulation was used to reduce the oscillatory momentum coefficient by roughly 50% with similar aerodynamic performance.

Author

Active Control; Separated Flow; Supercritical Flow; Airfoils; Trailing Edge Flaps; Flow Visualization

20030005517 Dynetics, Inc., Huntsville, AL USA

Approximate Methods for Center of Pressure Prediction of Multi-Segment Wings

Blackmar, Sarah C.; Miller, Mark S.; Blake, William B.; Oct. 2002; 13p; In English

Contract(s)/Grant(s): GS-23-F-0103K

Report No.(s): AD-A408524; AFRL-VA-WP-TP-2002-323; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Approximate methods for predicting the center of pressure of multi-segment wings are presented. Only wings with breaks in the leading edge sweep are considered. The methods transform a multi-segment planform into an equivalent straight tapered planform. Comparisons are made with predictions from a vortex lattice code and experimental data at subsonic speeds and with predictions from a vortex lattice and an Euler code at supersonic speeds. The most accurate method studied had an average error in predicted center of pressure location of approximately 2 percent of the root chord.

DTIC

Center of Pressure; Wings; Supersonic Speed; Approximation; Leading Edge Sweep

20030005575 Johns Hopkins Univ., Dept. of Mechanical Engineering, Baltimore, MD USA

Bubble Formation and Detachment in Reduced Gravity Under the Influence of Electric Fields

Herman, Cila, Johns Hopkins Univ., USA; Iacona, Estelle, Johns Hopkins Univ., USA; Chang, Shinan, Johns Hopkins Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 294-305; In English; Also announced as 20030005526; Original contains color illustrations; Sponsored in part by China Scholarship Council

Contract(s)/Grant(s): NAG3-1815; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The objective of the study is to investigate the behavior of individual air bubbles injected through an orifice into an electrically insulating liquid under the influence of a static electric field. Both uniform and nonuniform electric field configurations were considered. Bubble formation and detachment were recorded and visualized in reduced gravity (corresponding to gravity levels on Mars, on the Moon as well as microgravity) using a high-speed video camera. Bubble volume, dimensions and contact angle at detachment were measured. In addition to the experimental studies, a simple model, predicting bubble characteristics at

detachment was developed. The model, based on thermodynamic considerations, accounts for the level of gravity as well as the magnitude of the uniform electric field. Measured data and model predictions show good agreement and indicate that the level of gravity and the electric field magnitude significantly affect bubble shape, volume and dimensions.

Author

Bubbles; Microgravity; Fluid Dynamics; Electric Fields; Formations; Shapes; Surface Properties; Heat Transfer

20030005803 NASA Dryden Flight Research Center, Edwards, CA USA

Induced Moment Effects of Formation Flight Using Two F/A-18 Aircraft

Hansen, Jennifer L., NASA Dryden Flight Research Center, USA; Cobleigh, Brent R., NASA Dryden Flight Research Center, USA; August 2002; 23p; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 706-55-00-E8-28

Report No.(s): NASA/TM-2002-210732; NAS 1.15:210732; H-2502; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Previous investigations into formation flight have shown the possibility for significant fuel savings through drag reduction. Using two F/A-18 aircraft, NASA Dryden Flight Research Center has investigated flying aircraft in autonomous formation. Positioning the trailing airplane for best drag reduction requires investigation of the wingtip vortex effects induced by the leading airplane. A full accounting of the vortex effect on the trailing airplane is desired to validate vortex-effect prediction methods and provide a database for the design of a formation flight autopilot. A recent flight phase has mapped the complete wingtip vortex effects at two flight conditions with the trailing airplane at varying distances behind the leading one. Force and moment data at Mach 0.56 and an altitude of 25,000 ft and Mach 0.86 and an altitude of 36,000 ft have been obtained with 20, 55, 110, and 190 ft of longitudinal distance between the aircraft. The moments induced by the vortex on the trailing airplane were well within the pilot's ability to control. This report discusses the data analysis methods and vortex-induced effects on moments and side force. An assessment of the impact of the nonlinear vortex effects on the design of a formation autopilot is offered.

Author

Formation Flying; Autonomy; Drag Reduction; Prediction Analysis Techniques

20030005824 NASA Lewis Research Center, Cleveland, OH USA

Perspectives on the Mixing of a Row of Jets With a Confined Crossflow

Holdeman, J. D., NASA Lewis Research Center, USA; June 1983; 14p; In English; Nineteenth Joint Propulsion Conference, 27-29 Jun. 1983, Seattle, WA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 533-04-1A

Report No.(s): NASA/TM-83457; NAS 1.15:83457; E-1772; AIAA Paper 83-1200; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

An interactive computer code, written for a microcomputer, is presented which displays 2-D and 3-D oblique plots of the temperature distribution downstream of jets mixing with a confined crossflow, for either single-side or opposed jet injection. Temperature profiles calculated with this routine are presented to show the effects of flow and geometric variables on the mixing. Examples are also shown to illustrate the different perspectives on the mixing available by exercising various view options. In addition, the program is used to calculate profiles for opposed rows of jets with their centerlines in-line, by assuming that the confining effect of an opposite wall is equivalent to that of a plane of symmetry between opposed jets.

Author

Temperature Distribution; Microcomputers; Injection; Display Devices; Cross Flow; Computer Programs

20030006747 Politecnico di Milano, Dipt. di Ingegneria Aerospaziale, Milan Italy

Adaptive Finite Element Methods for Rotary Wing Aerodynamics Final Report

Bottasso, Carlo L.; Micheletti, Stefano; Sacco, Riccardo; Jul. 2002; 64p; In English

Contract(s)/Grant(s): N68171-01-M-5866

Report No.(s): AD-A408198; ARDSG-R/D-8928-AN-015; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We report on the research activity developed under the present contract in the field of anisotropic mesh adaption and error estimation. With respect to the former problem, we describe a method for the insertion of anisotropic mesh layers in general tetrahedral grids. For a-posteriori error estimation, we describe an implementation of a recovery-based estimator and its extension

to anisotropic metric-based adaption strategies. Selected examples illustrate the characteristics of the proposed procedures. We conclude by commenting on the results of the research activity and by discussing possible future work in the same field.

DTIC

Aerodynamics; Rotary Wing Aircraft; Aerodynamic Characteristics; Finite Element Method

03

AIR TRANSPORTATION AND SAFETY

Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation. For related information see also 16 Space Transportation and Safety; and 85 Technology Utilization and Surface Transportation.

20030005106 San Jose State Univ., CA USA

CATS-based Air Traffic Controller Agents

Callantine, Todd J., San Jose State Univ., USA; October 2002; 62p; In English

Contract(s)/Grant(s): RTOP 728-20-10; RTOP 727-01-23

Report No.(s): NASA/CR-2002-211856; NAS 1.26:211856; IH-031; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes intelligent agents that function as air traffic controllers. Each agent controls traffic in a single sector in real time; agents controlling traffic in adjoining sectors can coordinate to manage an arrival flow across a given meter fix. The purpose of this research is threefold. First, it seeks to study the design of agents for controlling complex systems. In particular, it investigates agent planning and reactive control functionality in a dynamic environment in which a variety perceptual and decision making skills play a central role. It examines how heuristic rules can be applied to model planning and decision making skills, rather than attempting to apply optimization methods. Thus, the research attempts to develop intelligent agents that provide an approximation of human air traffic controller behavior that, while not based on an explicit cognitive model, does produce task performance consistent with the way human air traffic controllers operate. Second, this research sought to extend previous research on using the Crew Activity Tracking System (CATS) as the basis for intelligent agents. The agents use a high-level model of air traffic controller activities to structure the control task. To execute an activity in the CATS model, according to the current task context, the agents reference a 'skill library' and 'control rules' that in turn execute the pattern recognition, planning, and decision-making required to perform the activity. Applying the skills enables the agents to modify their representation of the current control situation (i.e., the 'flick' or 'picture'). The updated representation supports the next activity in a cycle of action that, taken as a whole, simulates air traffic controller behavior. A third, practical motivation for this research is to use intelligent agents to support evaluation of new air traffic control (ATC) methods to support new Air Traffic Management (ATM) concepts. Current approaches that use large, human-in-the-loop simulations are unquestionably valuable for this purpose, but pose considerable logistical, fiscal, and experimental control problems. First, data analysis is extremely complicated, owing simply to the large number of participants and data sources in such simulations. In addition, experienced human air traffic controllers working adjacent sectors tend to flexibly adapt to the evolving control problem - potentially shifting to other strategies than those under investigation. In addition, their performance is tightly coupled to the control interface, which in the development phase may support some concepts and supporting strategies better than others. A simple shift in strategy by one controller can change the character of a particular traffic scenario dramatically, which makes experimental comparison of ATC performance under different traffic scenarios difficult. Training a given team of controllers on operations under a new ATM concept for a sufficient period of time could avert such difficulties, but instituting an adequate training program is expensive and logistically difficult.

Author

Air Traffic Controllers (Personnel); Air Traffic Control; Flight Management Systems; Decision Making; Complex Systems; Decision Support Systems; Applications Programs (Computers); Heuristic Methods; Computerized Simulation

04

AIRCRAFT COMMUNICATIONS AND NAVIGATION

Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications; Spacecraft Communications, Command and Tracking, and 32 Communications and Radar.

20030006745 Universitaet der Bundeswehr Muenchen, Fakultae fuer Bauingenieur- UND Vermessungswesen, Neubiberg Germany

Development of a Highly Precise DGPS-DGLONASS Navigation System with Particular Regard to Pseudolites

Werner, Wolfgang; Jan. 1999; 233p; In English; In German

Report No.(s): AD-A408195; HFT64/1999; X5-X5; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The dissertation concerns the concepts of GPS (Global Positioning System), a term originally used by the USA Department of Defense, and GLONASS (Global Navigation Satellite System). The NAVSTAR GPS, or Navigation System Using Time and Ranging, and how it is built and functions, is the subject of the first chapter following the introduction. The parameters, methods of observation, and sources of possible error are then outlined. The focus then shifts to GLONASS and, more importantly, to comparing UPS and GLONASS. The next section concerns pseudolites, which subsequently are integrated into working models involving a pulse scheme. The results and an overview of other potential methods comprise the final chapter.

DTIC

Global Positioning System; Navigation Satellites

20030006757 Johns Hopkins Univ., Applied Physics Lab., Laurel, MD USA

GPS Instrumentation in Ballistic Missile Intercept Test and Evaluation

Thompson, Thomas; Jul. 29, 2002; 9p; In English; Original contains color images; See Also ADM201460. Papers from Unclassified Proceedings from the 11th Annual AAIA/MDA Technology Conference held in Monterey, CA, 29 Jul-2 Aug 2002.

The original document contains color images

Report No.(s): AD-A408216; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

GPS instrumentation capable of measuring a missile intercept event with less than 2-centimeter accuracy has been demonstrated in a special high speed/acceleration sled test at Holloman AFB. Although the basic instrumentation technique is well defined, plans to properly exploit this capability are yet to be adequately addressed. This paper reviews the demonstrated differential GPS instrumentation technique that achieves 2-centimeter accuracy and then discusses the factors that need be addressed to properly exploit this capability. It describes the important and unique attributes of high-precision GPS measurements in regard to missile intercept evaluation. The difference between accurate GPS end-game trajectory measurements and a direct impact-point measurement are contrasted to emphasize the benefits of the GPS methodology. The basis for the preferred translator-based versus receiver-based GPS instrumentation is discussed with particular attention to the risk benefit of the translator approach. The challenges of GPS instrumentation on the interceptor are discussed with suggested implementation alternatives related to antenna design, digital versus analog translator design, dual versus single frequency use, and GPS signal bandwidth. Finally, an instrument configuration is described that can achieve the desired measurement accuracy with minimum risk.

DTIC

Global Positioning System; Instruments; Ballistic Missile Decoys

05

AIRCRAFT DESIGN, TESTING AND PERFORMANCE

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles, see 85 Technology Utilization and Surface Transportation.

20030004753 NASA Dryden Flight Research Center, Edwards, CA USA

Wing Torsional Stiffness Tests of the Active Aeroelastic Wing F/A-18 Airplane

Lokos, William A., NASA Dryden Flight Research Center, USA; Olney, Candida D., NASA Dryden Flight Research Center, USA; Crawford, Natalie D., NASA Dryden Flight Research Center, USA; Stauf, Rick, Spiral Technology, Inc., USA; Reichenbach, Eric Y., Boeing Co., USA; May 2002; 14p; In English; 43rd AIAA/ASME/ASCE/AHS Structures, Structural

Dynamics and Materials Conference, Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 706-35-00-E8-14

Report No.(s): NASA/TM-2002-210723; H-2481; NAS 1.15:210723; AIAA Paper 2002-1333; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The left wing of the Active Aeroelastic Wing (AAW) F/A-18 airplane has been ground-load-tested to quantify its torsional stiffness. The test has been performed at the NASA Dryden Flight Research Center in November 1996, and again in April 2001 after a wing skin modification was performed. The primary objectives of these tests were to characterize the wing behavior before the first flight, and provide a before-and-after measurement of the torsional stiffness. Two streamwise load couples have been applied. The wing skin modification is shown to have more torsional flexibility than the original configuration has. Additionally, structural hysteresis is shown to be reduced by the skin modification. Data comparisons show good repeatability between the tests.

Author

Aeroelasticity; Stiffness; Wings; F-18 Aircraft; Torsion; Load Tests; Aerodynamic Configurations; Mathematical Models

20030005461 NASA Langley Research Center, Hampton, VA USA

Analysis, Design and Optimization of Non-Cylindrical Fuselage for Blended-Wing-Body (BWB) Vehicle

Mukhopadhyay, V., NASA Langley Research Center, USA; Sobieszczanski-Sobieski, J., NASA Langley Research Center, USA; Kosaka, I., Vanderplaats Research and Development, Inc., USA; Quinn, G., Vanderplaats Research and Development, Inc., USA; Charpentier, C., Vanderplaats Research and Development, Inc., USA; [2002]; 10p; In English; 9th AIAA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, 4-6 Sep. 2002, Atlanta, GA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-5664; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Initial results of an investigation towards finding an efficient non-cylindrical fuselage configuration for a conceptual blended-wing-body flight vehicle were presented. A simplified 2-D beam column analysis and optimization was performed first. Then a set of detailed finite element models of deep sandwich panel and ribbed shell construction concepts were analyzed and optimized. Generally these concepts with flat surfaces were found to be structurally inefficient to withstand internal pressure and resultant compressive loads simultaneously. Alternatively, a set of multi-bubble fuselage configuration concepts were developed for balancing internal cabin pressure load efficiently, through membrane stress in inner-stiffened shell and inter-cabin walls. An outer-ribbed shell was designed to prevent buckling due to external resultant compressive loads. Initial results from finite element analysis appear to be promising. These concepts should be developed further to exploit their inherent structural efficiency.

Author

Design Optimization; Blended-Wing-Body Configurations; Fuselages; Panels; Sandwich Structures; Shells (Structural Forms)

20030005489 NASA Langley Research Center, Hampton, VA USA

Simulation and Flight Control of an Aeroelastic Fixed Wing Micro Aerial Vehicle

Waszak, Martin, NASA Langley Research Center, USA; Davidson, John B., NASA Langley Research Center, USA; Ifju, Peter G., Florida Univ., USA; [2002]; 12p; In English; AIAA Atmospheric Flight Mechanics Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4875; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Micro aerial vehicles have been the subject of continued interest and development over the last several years. The majority of current vehicle concepts rely on rigid fixed wings or rotors. An alternate design based on an aeroelastic membrane wing has also been developed that exhibits desired characteristics in flight test demonstrations, competition, and in prior aerodynamics studies. This paper presents a simulation model and an assessment of flight control characteristics of the vehicle. Linear state space models of the vehicle associated with typical trimmed level flight conditions and which are suitable for control system design are presented as well. The simulation is used as the basis for the design of a measurement based nonlinear dynamic inversion control system and outer loop guidance system. The vehicle/controller system is the subject of ongoing investigations of autonomous and collaborative control schemes. The results indicate that the design represents a good basis for further development of the micro aerial vehicle for autonomous and collaborative controls research.

Author

Aeroelasticity; Automatic Control; Simulation; Flight Control; Pilotless Aircraft; Control Systems Design; Membrane Structures

20030005709 Institute for Environmental Safety and Occupational Risk Analysis, Risk Analysis Directorate, Brooks AFB, TX USA

C-17 Confined Space Technical Guidance Document Final Report

Kapranos, Sophia; Costantino, Joseph; Hintz, Tammy J.; Aug. 2002; 54p; In English; Original contains color images; Prepared in collaboration with Pacific Environmental Services, Inc., Herndon, VA

Report No.(s): AD-A408125; IERA-RS-BR-TR-2002-0003; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The following information and instructions apply to permit-required and nonpermit-required confined spaces associated with the C-17 aircraft. The majority of activities conducted within these spaces are for inspections and routine scheduled maintenance only. Flightline, depot, and other related activities are not referenced in this document. The information presented for each space type is based on the dimensions, inner characteristics, and interviews with shop personnel. Personnel performing aircraft maintenance and support are extensively trained in safe work practices, and work is conducted in accordance with (IAW) strict Technical Order (TO) and Operating Instruction (OI) directives. The TOs and OIs govern procedures such as lockout/tagout and system checks prior to entering the various areas of an aircraft.

DTIC

Aircraft Maintenance; Transport Aircraft

20030005710 Institute for Environmental Safety and Occupational Risk Analysis, Risk Analysis Directorate, Brooks AFB, TX USA

C-141 Confined Space Technical Guidance Document Final Report

Kapranos, Sophia; Costantion, Joseph; Hintz, Tammy J.; Aug. 2002; 42p; In English; Original contains color images; Prepared in collaboration with Pacific Environmental Services, Inc., Herndon, VA

Report No.(s): AD-A408124; IERA-RS-BR-TR-2002-0001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The following information and instructions apply to permit-required and nonpermit-required confined spaces associated with the C-141 aircraft. The majority of activities conducted within these spaces are for inspections and routine scheduled maintenance only. Flightline, depot, and other related activities are not referenced in this document. The information presented for each space type is based on the dimensions, inner characteristics, and interviews with shop personnel. Personnel performing aircraft maintenance and Support are extensively trained in safe work practices, and work is conducted in accordance with (IAW) strict Technical Order (TO) and Operating Instruction (OI) directives. The TOs and OIs govern procedures such as lockout/tagout and system checks prior to entering the various areas of an aircraft.

DTIC

Aircraft Maintenance; Transport Aircraft

20030005711 Institute for Environmental Safety and Occupational Risk Analysis, Risk Analysis Directorate, Brooks AFB, TX USA

C-5 Confined Space Technical Guidance Document Final Report

Kapranos, Sophia; Costantino, Joseph; Hintz, Tammy J.; Aug. 2002; 110p; In English; Original contains color images; Prepared in collaboration with Pacific Environmental Services, Inc., Herndon, VA

Report No.(s): AD-A408123; IERA-RS-BR-TR-2002-0002; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The following information and instructions apply to permit-required and nonpermit-required confined spaces associated with the C-5 aircraft. The majority of activities conducted within these spaces are for inspections and routine scheduled maintenance only. Flightline, depot, and other related activities are not referenced in this document. The information presented for each space type is based on the dimensions, inner characteristics, and interviews with shop personnel. Personnel performing aircraft maintenance and support are extensively trained in safe work practices, and work is conducted in accordance with (IAW) strict Technical Order (TO) and Operating Instruction (OI) directives. The TOs and OIs govern procedures such as lockout/tagout and system checks prior to entering the various areas of an aircraft.

DTIC

Aircraft Maintenance; Transport Aircraft

20030005804 NASA Dryden Flight Research Center, Edwards, CA USA

Flight Test Techniques Used to Evaluate Performance Benefits During Formation Flight

Ray, Ronald J., NASA Dryden Flight Research Center, USA; Cobleigh, Brent R., NASA Dryden Flight Research Center, USA; Vachon, M. Jake, NASA Dryden Flight Research Center, USA; SaintJohn, Clinton, NASA Dryden Flight Research Center, USA; August 2002; 25p; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 706-35-00-E8-28

Report No.(s): NASA/TP-2002-210730; NAS 1.60:210730; H-2500; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The Autonomous Formation Flight research project has been implemented at the NASA Dryden Flight Research Center to demonstrate the benefits of formation flight and develop advanced technologies to facilitate exploiting these benefits. Two F/A-18 aircraft have been modified to precisely control and monitor relative position, and to determine performance of the trailing airplane. Flight test maneuvers and analysis techniques have been developed to determine the performance advantages, including drag and fuel flow reductions and improvements in range factor. By flying the trailing airplane through a matrix of lateral, longitudinal, and vertical offset positions, a detailed map of the performance benefits has been obtained at two flight conditions. Significant performance benefits have been obtained during this flight test phase. Drag reductions of more than 20 percent and fuel flow reductions of more than 18 percent have been measured at flight conditions of Mach 0.56 and an altitude of 25,000 ft. The results show favorable agreement with published theory and generic predictions. An F/A-18 long-range cruise mission at Mach 0.8 and an altitude of 40,000 ft has been simulated in the optimum formation position and has demonstrated a 14-percent fuel reduction when compared with a controlled chase airplane of similar configuration.

Author

Flight Tests; Fuel Flow; Drag; Autonomy; Formation Flying

20030005814 Air Force Inst. for Environment, Safety and Occupational Health Risk Analysis, Brooks AFB, TX USA

KC-10 Confined Space Technical Guidance Document

Kapranos, Sophia; Costantino, Joseph; Hintz, Tammy J.; Aug. 2002; 70p; In English; Original contains color images

Report No.(s): AD-A408235; IERA-RS-BR-TR-2002-0004; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The following information and instructions apply to permit-required and nonpermit-required confined spaces associated with the KC-10 aircraft. The majority of activities conducted within these spaces are for inspections and routine scheduled maintenance only. Flightline, depot, and other related activities are not referenced in this document. The information presented for each space type is based on the dimensions, inner characteristics, and interviews with shop personnel. Personnel performing aircraft maintenance and support are extensively trained in safe work practices, and work is conducted in accordance with (IAW) strict Technical Order (TO) and Operating Instruction (OI) directives. The TOs and OIs govern procedures such as lockout/tagout and system checks prior to entering the various areas of an aircraft.

DTIC

Aircraft Maintenance; Transport Aircraft; Procedures

20030005815 Air Force Inst. for Environment, Safety and Occupational Health Risk Analysis, Brooks AFB, TX USA

C-130 Confined Space Technical Guidance Document Final Report

Kapranos, Sophia; Costantino, Joseph; Hintz, Tammy J.; Aug. 2002; 30p; In English; Original contains color images; --Original contains color plates: All DTIC reproductions will be in black and white. Prepared in cooperation with Pacific Environmental Services, Inc., Herndon, VA

Report No.(s): AD-A408236; IERA-RS-BR-TR-2002-0006; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The following information and instructions apply to permit-required and nonpermit-required confined spaces associated with the C-130 aircraft. The majority of activities conducted within these spaces are for inspections and routine scheduled maintenance only. Flightline, depot and other related activities are not referenced in this document. The information presented for each space type is based on the dimensions, inner characteristics, and interviews with shop personnel. Personnel performing aircraft maintenance and support are extensively trained in safe work practices, and work is conducted in accordance with (IAW) Strict Technical Order (TO) and Operating Instruction (OI) directives. The TOs and OIs govern procedures such as lockout/tagout and system checks prior to entering the various areas of an aircraft.

DTIC

Aircraft Maintenance; Management; Transport Aircraft; Procedures

20030005817 Air Force Inst. for Environment, Safety and Occupational Health Risk Analysis, Risk Analysis Directorate, Brooks AFB, TX USA

F-16 Confined Space Technical Guidance Document Final Report

Kapranos, Sophia; Costantino, Joseph; Hintz, Tammy J.; Aug. 2002; 22p; In English; Original contains color images; Prepared in collaboration with Pacific Environmental Services, Inc., Herndon, VA

Report No.(s): AD-A408238; IERA-RS-BR-TR-2002-0005; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The following information and instructions apply to permit-required and nonpermit-required confined spaces associated with the F-16 aircraft. The majority of activities conducted within these spaces are for inspections and routine scheduled maintenance only. Flightline, depot, and other related activities are not referenced in this document. The information presented for each space type is based on the dimensions, inner characteristics, and interviews with shop personnel. Personnel performing aircraft maintenance and support are extensively trained in safe work practices, and work is conducted in accordance with (IAW) strict Technical Order (TO) and Operating Instruction (OI) directives. The TOs and OIs govern procedures such as lockout/tagout and system checks prior to entering the various areas of an aircraft.

DTIC

Aircraft Maintenance; Management; F-16 Aircraft; Procedures

20030005846 NASA Langley Research Center, Hampton, VA USA

Development of Micro Air Reconnaissance Vehicle as a Test Bed for Advanced Sensors and Electronics

Shams, Qamar A., NASA Langley Research Center, USA; Vranas, Thomas L., NASA Langley Research Center, USA; Fox, Robert L., NASA Langley Research Center, USA; Kuhn, Theodore R., NASA Langley Research Center, USA; Ingham, John, NASA Langley Research Center, USA; Logan, Michael J., NASA Langley Research Center, USA; Barnes, Kevin N., NASA Langley Research Center, USA; Guenther, Benjamin F., NASA Langley Research Center, USA; [2002]; 24p; In English; 1st AIAA Unmanned Aerospace Vehicles, Systems, Technologies and Operations Technical Conference and Workshop, 20-23 May 2002, Portsmouth, VA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-3411; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

This paper describes the development of a Micro/Mini Air Reconnaissance Vehicle for advanced sensors and electronics at NASA Langley Research Center over the last year. This vehicle is expected to have a total weight of less than four pounds, a design velocity of 40 mph, an endurance of 15-20 minutes, and a maximum range of 5km. The vehicle has wings that are simple to detach yet retain the correct alignment. The upper fuselage surface has a quick release hatch used to access the interior and also to mount the varying propulsion systems. The sensor suite developed for this vehicle consists of a Pitot-static measurement system for determining air speed, an absolute pressure measurement for determining altitude, magnetic direction measurement, and three orthogonal gyros to determine body angular rates. Swarming GPS-guidance and in-flight maneuvering is discussed, as well as design and installation of some other advance sensors like MEMS microphones, infrared cameras, GPS, humidity sensors, and an ultrasonic sonar sensor. Also low cost, small size, high performance control and navigation system for the Micro Air Vehicle is discussed. At the end, laboratory characterization of different sensors, motors, propellers, and batteries will be discussed.

Author

Angular Velocity; Fuselages; Gyroscopes; Pressure Measurement; Propulsion System Configurations; Propulsion System Performance; Reconnaissance Aircraft

20030005954 Air Force Research Lab., Wright-Patterson AFB, OH USA

A Comparison of HMD Ownship Status Symbology and Frame of Reference Orientation During Two Aircraft Control Tasks

Havig, Paul R.; Jenkins, Joseph C.; Geiselman, Eric E.; Nov. 2002; 14p; In English

Contract(s)/Grant(s): Proj-7184

Report No.(s): AD-A408498; AFRL-HE-WP-TR-2002-0224; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Recent technological advances allow symbology to be displayed on the pilot's visor. A major benefit of this is that the pilots will be able to take this information with them when they look off-boresight. However, when looking off-boresight, the question arises as to what is the best orientation, or frame of reference, for attitude symbology against the horizon (i.e., forward or line-of-sight) in order to maximize interpretation and performance. This study tested five different symbolologies (standard HUD, visually coupled acquisition and targeting symbology, arc segmented attitude reference, theta ball, and non-distributed flight reference) of which three have both forward and line-of-sight orientations. The experiment consisted of two distributed tasks, with the pilots performing either facing the monitor or rotated 90 degrees and looking over their shoulder (off-boresight). In the first task, pilots maintained straight and level flight with simulated turbulence. The second task had pilots interpret a static representation of their attitude and respond via a key press, and then the display went live and they had to fly to a new commanded attitude. This second task was similar to a recovery from unusual attitude methodology, except the end state was never straight and level. Instead, a second unknown end-state attitude was commanded by the experiment. Results indicate that performance is better when the symbology is forward as opposed to line-of-sight referenced. Further, performance was best in both tasks for

the non-distributed flight reference. We discuss these results in terms of implications for helmet-mounted display symbology design.

DTIC

Aircraft; Helmet Mounted Displays; Head-Up Displays

20030006113 Ballistic Research Labs., Aberdeen Proving Ground, MD USA

The Measurement of Non-Linear Forces and Moments by Means of Free Flight Tests

Murphy, Charles H.; Feb. 1956; 50p; In English

Report No.(s): AD-A408436; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

It has been observed, that the behavior of missiles either moving under the influence of non-linear forces and moments or flying at large angles of yaw is frequently well described by curves of the same form as those generated by linear force systems and small angles of yaw. With this in mind an "equivalent" linear solution to the actual equations of yawing motion is obtained. This equivalent linear solution has been used in the analysis of a wide variety of programs fired on HRL's Spark Ranges and considerable success has been experienced. Excellent internal consistency has been observed in measuring non-linear normal and Magnus forces and their moments and, in all cases where wind tunnel results were available, they were in good agreement with range results. The application of this technique to the equally important problem of predicting yawing motion is described.

DTIC

Flight Tests; Free Flight; Nonlinearity; Aerodynamic Characteristics

20030006257 Air Force Inst. for Environment, Safety and Occupational Health Risk Analysis, Risk Analysis Directorate, Brooks AFB, TX USA

B-1 Confined Space Technical Guidance Document Final Report

Kapranos, Sophia; Costantino, Joseph; Hintz, Tammy J.; Aug. 2002; 33p; In English; Original contains color images; Prepared in collaboration with Pacific Environmental Services, Inc., Herndon, VA

Report No.(s): AD-A408247; IERA-RS-BR-TR-2002-0007; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The following information and instructions apply to permit-required and nonpermit-required confined spaces associated with the B-1 aircraft. The majority of activities conducted within these spaces are for inspections and routine scheduled maintenance only. Flightline, depot, and other related activities are not referenced in this document. The information presented for each space type is based on the dimensions, inner characteristics, and interviews with shop personnel. Personnel performing aircraft maintenance and support are extensively trained in safe work practices, and work is conducted in accordance with (IAW) strict Technical Order (TO) and Operating Instruction (OI) directives. The TOs and OIs govern procedures such as lockout/tagout and system checks prior to entering the various areas of an aircraft.

DTIC

Aircraft Maintenance; Inspection; Personnel

06

AVIONICS AND AIRCRAFT INSTRUMENTATION

Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles, see 85 Technology Utilization and Surface Transportation.

20030006677 NASA Langley Research Center, Hampton, VA USA

Autoreturn Function for a Remotely Piloted Vehicle

McMinn, J. D., NASA Langley Research Center, USA; Jackson, E. Bruce, NASA Langley Research Center, USA; [2002]; 12p; In English; Guidance, Navigation and Control Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4673; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

An algorithm to maneuver an air vehicle to intercept and follow a pre-planned path while remaining within an arbitrary, closed boundary is outlined. The immediate application is for an autonomous lost-link return-to-runway function for a remotely piloted

vehicle being developed by NASA, but other applications are hypothesized. Results of implementation in a flight simulator are given.

Author

Remotely Piloted Vehicles; Flight Simulators; Algorithms

07

AIRCRAFT PROPULSION AND POWER

Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.

20030004840 Oklahoma State Univ., School of Mechanical and Aerospace Engineering, Stillwater, OK USA

Lateral Jet Injection Into Typical Combustor Flowfields *Final Report, 1 May 1984 - 31 Jan. 1986*

Lilley, David G., Oklahoma State Univ., USA; July 1986; 97p; In English

Contract(s)/Grant(s): NAG3-549

Report No.(s): NASA-CR-3997; NAS 1.26:3997; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

This is the Final Report on Grant NAG 3-549 and discussion is on those activities undertaken during the entire 1-yr research program which began May 1, 1984 and ended April 30, 1985 with no-cost time extension to January 31, 1986. Studies were concerned with the experimental problem of lateral jet injection into typical combustor flowfields in the absence of combustion. All flowfields being investigated have no expansion of the crossflow (the test section to swirler diameter ratio $D/d = 1$), after its passage through an optional swirler (with swirl vane angle $\phi = 0$ (swirler removed), 45 deg and 70 deg. The lateral jet(s) is(are) located one test-section diameter downstream of the test-section inlet ($x/D = 1$). The lateral jets have round-sectioned nozzles, each of which has an area of 1/100th of the cross-sectional area of the crossflow ($A_{\text{sub } j}/A_{\text{sub } c} = 1/100$). Jet-to-crossflow velocity ratios of $R = v_{\text{sub } j}/u_{\text{sub } o} = 2, 4$, and 6 were investigated. Helium-bubble flow visualization, five-hole pitot probe time-mean velocity measurements, and single-wire time-mean velocity and normal and shear stress turbulence data were obtained in the research program.

Author

Flow Distribution; Combustion Chambers; Injection; Jet Mixing Flow; Flow Measurement; Time Measurement; Velocity Measurement; Scientific Visualization

20030004850 Case Western Reserve Univ., Dept. of Mechanical and Aerospace Engineering, Cleveland, OH USA

Dilution Jets in Accelerated Cross Flows *Final Report*

Lipshitz, Abraham, Case Western Reserve Univ., USA; Greber, Isaac, Case Western Reserve Univ., USA; June 1984; 315p; In English

Contract(s)/Grant(s): NSG-3206; RTOP 505-36-22

Report No.(s): NASA-CR-174717; NAS 1.26:174717; No Copyright; Avail: CASI; A14, Hardcopy; A03, Microfiche

Results of flow visualization experiments and measurements of the temperature field produced by a single jet and a row of dilution jets issued into a reverse flow combustor are presented. The flow in such combustors is typified by transverse and longitudinal acceleration during the passage through its bending section. The flow visualization experiments were designed to examine the separate effects of longitudinal and transverse acceleration on the jet trajectory and spreading rate. A model describing a dense single jet in a lighter accelerating cross flow is developed. The model is based on integral conservation equations, including the pressure terms appropriate to accelerating flows. It uses a modified entrainment correlation obtained from previous experiments of a jet in a cross stream. The flow visualization results are compared with the model calculations in terms of trajectories and spreading rates. Each experiment is typified by a set of three parameters: momentum ratio, density ratio, and the densimetric Froude number. When injection velocities are large or densities are small, the Froude number becomes very large and hence, unimportant. Therefore, the Froude number is generally significant in describing liquid experiments but is unimportant for the gas experiments in the combustor. Agreement between test and calculated results is encouraging but tends to become poorer with increasing momentum ratio. The temperature measurements are presented primarily in the form of consecutive normalized temperature profiles. Some interpolated isothermal contours are also shown. The single jet trajectories are consistently found to be swept towards the inner wall of the bend, whether injection is from the outer or the inner wall. This behavior is explained by a drifting effect which consists of a transverse velocity component across the combustor due to the developing nature of the flow along it. Plots of lateral temperature distributions of the jet indicate that under longitudinal acceleration conditions the thermal spreading of the jet may be completely suppressed. Comparison between combustor experimental results and model calculations

shows poor agreement due to the drifting effect which is not taken into consideration in the model calculations. The row of jets experiments are characterized by two additional parameters: spacing ratio and confinement parameter. The results are shown in the form of consecutive normalized temperature profiles. The confinement parameter appears to become increasingly important with decreasing spacing ratio, in particular when its effect is enhanced by the drifting phenomenon and associated pressure field. A tightly spaced row of jets injected from the inner wall, prior to the bend, is surprisingly kept attached to the inner wall in spite of the strong turning. A similar attachment for a jet injected from the outer wall is not observed.

Author

Dilution; Cross Flow; Temperature Distribution; Transverse Acceleration; Pressure Distribution; Flow Visualization; Froude Number

20030005442 Michigan State Univ., College of Engineering, East Lansing, MI USA

Development of a Temperature Measurement System With Application to a Jet in a Cross Flow Experiment *Final Report*

Wark, Candace, Michigan State Univ., USA; Foss, John F., Michigan State Univ., USA; May 1985; 124p; In English

Contract(s)/Grant(s): NAG3-245; RTOP 533-04-12

Report No.(s): NASA/CR-174896; NAS 1.26:174896; FSFL-R-85-002; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

A temperature measurement system, which allows the simultaneous sampling (each 0.64 m/s) of up to 80 separate thermocouples, has been developed. The minimum resolution for the system corresponds to ± 0.16 C per least significant bit of the A/D converter. Electronic and thermal noise give an effective resolution of nominally ± 0.44 C. The time constant values for each of the 64 thermocouples, were determined experimentally at 7 mps. A 'universal' form of the velocity dependence: $\lambda = \lambda(u)$ for $2 \leq u \leq 12$ mps, was analytically inferred and experimentally verified for four thermocouples. Software routines were used to correct the measured temperatures for the effect of λ for each thermocouple. The temperature measurement system has been utilized to study the thermal field of a heated jet discharging perpendicularly into a low ($u/U(\infty) = 0.6$ percent) and a high ($u/U(\infty) = 34$ percent) disturbance level cross stream for a given momentum flux ratio ($J = \rho(u) V^2 / \rho(\infty) U^2$) and for three overheated values ($T(u) - T(\infty) = 22.2, 41.7, 66.2$ C). The peak instantaneous temperatures ($X/d = 3 - 4$) reveal that strong molecular diffusion has been operative: $(T - T(\infty)) / (T(u) - T(\infty))$ is less than or equal to 0.25. Various measures of the thermal field, for the disturbed case, suggest that the jet column remains relatively compact while being buffeted by the ambient turbulence field and that its penetration, into the cross wind, is inhibited by the presence of the strong disturbance field.

Author

Temperature Measurement; Jet Flow; Cross Flow; Velocity; Molecular Diffusion; Turbulence

20030005488 NASA Langley Research Center, Hampton, VA USA

Experiments and Analyses of Distributed Exhaust Nozzles

Kinzie, Kevin W., NASA Langley Research Center, USA; Schein, David B., Northrop Grumman Integrated Systems, USA; Solomon, W. David, Jr., Northrop Grumman Integrated Systems, USA; [2002]; 12p; In English; 8th AIAA/CEAS Aeroacoustic Conference, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS1-02046

Report No.(s): AIAA Paper 2002-2555; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Experimental and analytical aeroacoustic properties of several distributed exhaust nozzle (DEN) designs are presented. Significant differences between the designs are observed and correlated back to Computational Fluid Dynamics (CFD) flowfield predictions. Up to 20 dB of noise reduction on a spectral basis and 10 dB on an overall sound pressure level basis are demonstrated from the DEN designs compared to a round reference nozzle. The most successful DEN designs acoustically show a predicted thrust loss of approximately 10% compared to the reference nozzle. Characteristics of the individual mini-jet nozzles that comprise the DEN such as jet-jet shielding and coalescence are shown to play a major role in the noise signature.

Author

Exhaust Nozzles; Aeroacoustics; Nozzle Design; Flow Distribution

20030005822 NASA Lewis Research Center, Cleveland, OH USA

Mixing of Multiple Jets With a Confined Subsonic Crossflow: Summary of NASA-Supported Experiments and Modeling

Holdeman, James D., NASA Lewis Research Center, USA; June 1991; 49p; In English; 27th Joint Propulsion Conference, 24-27

Jun. 1991, Sacramento, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 537-02-21

Report No.(s): NASA/TM-104412; NAS 1.15:104412; E-6239; AIAA Paper 91-2458; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

This paper summarizes experimental and computational results on the mixing of single, double, and opposed rows of jets with an isothermal or variable temperature mainstream in a confined subsonic crossflow. The studies from which these results came were performed to investigate flow and geometric variations typical of the complex 3-D flowfield in the dilution zone of combustion chambers in gas turbine engines. The principal observations from the experiments were that the momentum-flux ratio was the most significant flow variable, and that temperature distributions were similar, independent of orifice diameter, when the orifice spacing and the square-root of the momentum-flux ratio were inversely proportional. The experiments and empirical model for the mixing of a single row of jets from round holes were extended to include several variations typical of gas turbine combustors, namely variable temperature mainstream, flow area convergence, non-circular orifices, and double and opposed rows of jets, both in-line and staggered. All except the last of these were appropriately modelled with superposition or patches to the basic empirical model. Combinations of flow and geometry that gave optimum mixing were identified from the experimental results. Based on the results of calculations made with a three-dimensional numerical model, the empirical model was further extended to model the effects of curvature and convergence. The principal conclusions from this study were that the orifice spacing and momentum-flux relationships were the same as observed previously in a straight duct, but the jet structure was significantly different for jets injected from the inner wall of a turn than for those injected from the outer wall. Also, curvature in the axial direction caused a drift of the jet trajectories toward the inner wall, but the mixing in a turning and converging channel did not seem to be inhibited by the convergence, independent of whether the convergence was radial or circumferential. The calculated jet penetration and mixing in an annulus were similar to those in a rectangular duct when the orifice spacing was specified at the radius dividing the annulus into equal areas.

Author

Fluid Jets; Jet Mixing Flow; Flow Distribution; Cross Flow; Flow Geometry

20030005823 NASA Glenn Research Center, Cleveland, OH USA

WIND Validation Cases: Computational Study of Thermally-Perfect Gases

DalBello, Teryn, NASA Glenn Research Center, USA; December 2002; 17p; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NCC3-922; RTOP 708-90-31

Report No.(s): NASA/CR-2002-212015; NAS 1.26:212015; E-13704; ICOMP-2002-07; AIAA Paper 2003-0546; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The ability of the WIND Navier-Stokes code to predict the physics of multi-species gases is investigated in support of future high-speed, high-temperature propulsion applications relevant to NASA's Space Transportation efforts. Three benchmark cases are investigated to evaluate the capability of the WIND chemistry model to accurately predict the aerodynamics of multi-species chemically non-reacting (frozen) gases. Case 1 represents turbulent mixing of sonic hydrogen and supersonic vitiated air. Case 2 consists of heated and unheated round supersonic jet exiting to ambient. Case 3 represents 2-D flow through a converging-diverging Mach 2 nozzle. For Case 1, the WIND results agree fairly well with experimental results and that significant mixing occurs downstream of the hydrogen injection point. For Case 2, the results show that the Wilke and Sutherland viscosity laws gave similar results, and the available SST turbulence model does not predict round supersonic nozzle flows accurately. For Case 3, results show that experimental, frozen, and 1-D gas results agree fairly well, and that frozen, homogeneous, multi-species gas calculations can be approximated by running in perfect gas mode while specifying the mixture gas constant and Ratio of Specific Heats.

Author

Computation; Ideal Gas; Navier-Stokes Equation; Supersonic Jet Flow; Supersonic Speed; Turbulence Models; Turbulent Mixing

AIRCRAFT STABILITY AND CONTROL

Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also 05 Aircraft Design, Testing and Performance and 06 Avionics and Aircraft Instrumentation.

20030004787 NASA Dryden Flight Research Center, Edwards, CA USA

String Stability of a Linear Formation Flight Control System

Allen, Michael J., NASA Dryden Flight Research Center, USA; Ryan, Jack, NASA Dryden Flight Research Center, USA; Hanson, Curtis E., NASA Dryden Flight Research Center, USA; Parle, James F., University of Southern California, USA; August 2002; 17p; In English; AIAA Guidance, Navigation and Control Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 706-35-00-E8-20

Report No.(s): NASA/TM-2002-210733; H-2504; NAS 1.15:210733; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

String stability analysis of an autonomous formation flight system was performed using linear and nonlinear simulations. String stability is a measure of how position errors propagate from one vehicle to another in a cascaded system. In the formation flight system considered here, each i (sup th) aircraft uses information from itself and the preceding $((i-1)(sup th))$ aircraft to track a commanded relative position. A possible solution for meeting performance requirements with such a system is to allow string instability. This paper explores two results of string instability and outlines analysis techniques for string unstable systems. The three analysis techniques presented here are: linear, nonlinear formation performance, and ride quality. The linear technique was developed from a worst-case scenario and could be applied to the design of a string unstable controller. The nonlinear formation performance and ride quality analysis techniques both use nonlinear formation simulation. Three of the four formation-controller gain-sets analyzed in this paper were limited more by ride quality than by performance. Formations of up to seven aircraft in a cascaded formation could be used in the presence of light gusts with this string unstable system.

Author

Flight Control; Systems Engineering; Autonomy; Flight Stability Tests; Linearity

20030005459 Eloret Corp., Moffett Field, CA USA

Numerical Simulation of Rolling-Airframes Using a Multi-Level Cartesian Method

Murman, Scott M., Eloret Corp., USA; Aftosmis, Michael J., NASA Ames Research Center, USA; Berger, Marsha J., New York Univ., USA; Jun. 24, 2002; 14p; In English; AIAA Applied Aerodynamics Conference, Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 704-40-21

Report No.(s): AIAA Paper 2002-2798; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A supersonic rolling missile with two synchronous canard control surfaces is analyzed using an automated, inviscid, Cartesian method. Sequential-static and time-dependent dynamic simulations of the complete motion are computed for canard dither schedules for level flight, pitch, and yaw maneuver. The dynamic simulations are compared directly against both high-resolution viscous simulations and relevant experimental data, and are also utilized to compute dynamic stability derivatives. The results show that both the body roll rate and canard dither motion influence the roll-averaged forces and moments on the body. At the relatively, low roll rates analyzed in the current work these dynamic effects are modest, however the dynamic computations are effective in predicting the dynamic stability derivatives which can be significant for highly-maneuverable missiles.

Author

Airframes; Cartesian Coordinates; Stability Derivatives; Time Dependence; Inviscid Flow; Dynamic Stability; Canard Configurations

20030005491 NASA Langley Research Center, Hampton, VA USA

Linear Parameter Varying Control Synthesis for Actuator Failure, Based on Estimated Parameter

Shin, Jong-Yeob, NASA Langley Research Center, USA; Wu, N. Eva, State Univ. of New York, USA; Belcastro, Christine, NASA Langley Research Center, USA; [2002]; 12p; In English; AIAA Guidance, Navigation and Control Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS1-97046; NCC1-02009

Report No.(s): AIAA Paper 2002-4546; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The design of a linear parameter varying (LPV) controller for an aircraft at actuator failure cases is presented. The controller synthesis for actuator failure cases is formulated into linear matrix inequality (LMI) optimizations based on an estimated failure parameter with pre-defined estimation error bounds. The inherent conservatism of an LPV control synthesis methodology is reduced using a scaling factor on the uncertainty block which represents estimated parameter uncertainties. The fault parameter is estimated using the two-stage Kalman filter. The simulation results of the designed LPV controller for a HiMXT (Highly Maneuverable Aircraft Technology) vehicle with the on-line estimator show that the desired performance and robustness objectives are achieved for actuator failure cases.

Author

Actuators; Linear Parameter-Varying Control; Failure; Aircraft Control

20030005820 NASA Dryden Flight Research Center, Edwards, CA USA

An Overview of Flight Test Results for a Formation Flight Autopilot

Hanson, Curtis E., NASA Dryden Flight Research Center, USA; Ryan, Jack, NASA Dryden Flight Research Center, USA; Allen, Michael J., NASA Dryden Flight Research Center, USA; Jacobson, Steven R., NASA Dryden Flight Research Center, USA; August 2002; 19p; In English; AIAA Guidance, Navigation and Control Conference, Monterey, CA, Monterey, CA, Monterey, CA, Monterey, CA, USA, USA, USA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 706-35-00-E8-28

Report No.(s): NASA/TM-2002-210729; NAS 1.15:210729; H-2499; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The first flight test phase of the NASA Dryden Flight Research Center Autonomous Formation Flight project has successfully demonstrated precision autonomous station-keeping of an F/A-18 research airplane with a second F/A-18 airplane. Blended inertial navigation system (INS) and global positioning system (GPS) measurements have been communicated across an air-to-air telemetry link and used to compute relative-position estimates. A precision research formation autopilot onboard the trailing airplane controls lateral and vertical spacing while the leading airplane operates under production autopilot control. Four research autopilot gain sets have been designed and flight-tested, and each exceeds the project design requirement of steady-state tracking accuracy within 1 standard deviation of 10 ft. Performance also has been demonstrated using single- and multiple-axis inputs such as step commands and frequency sweeps. This report briefly describes the experimental formation flight systems employed and discusses the navigation, guidance, and control algorithms that have been flight-tested. An overview of the flight test results of the formation autopilot during steady-state tracking and maneuvering flight is presented.

Author

Automatic Pilots; Flight Tests; F-18 Aircraft; Global Positioning System; Guidance (Motion)

20030006461 NASA Langley Research Center, Hampton, VA USA

Overview of Active Flow Control Actuator Development at NASA Langley Research Center

Schaeffler, Norman W., NASA Langley Research Center, USA; Hepner, Timothy E., NASA Langley Research Center, USA; Jones, Gregory S., NASA Langley Research Center, USA; Kegerise, Michael A., NASA Langley Research Center, USA; [2002]; 13p; In English; 1st AIAA Flow Control Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-3159; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The paper provides an overview of the actuator development work that is currently underway at NASA Langley Research Center in the context of some of the Active Flow Control research being conducted at NASA Langley. The actuator development effort has provided a focused, centralized location for this work within NASA Langley. The multidisciplinary team approach utilized in this effort has allowed input from multiple disciplines on how various actuator challenges can be addressed and has lead to some unique approaches in actuation.

Author

Active Control; Actuators; Flow Distribution

RESEARCH AND SUPPORT FACILITIES (AIR)

Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see 03 Air Transportation and Safety. For astronautical facilities see 14 Ground Support Systems and Facilities (Space).

20030006259 Air Force Flight Dynamics Lab., Structural Vibration Branch, Wright-Patterson AFB, OH USA

Rapid Runway Repair Test Description Final Report, 1 Oct.-21 Oct. 1985

Banaszak, David; Rogers, Earl; Dec. 1985; 54p; In English

Report No.(s): AD-A408243; AFWAL-TM-85-258-FIBG; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes instrumentation used during Rapid Runway Repair (RRR) tests with a C-141B and C-5A at RAF Wethersfield during October 1-21, 1985. The RRR test objectives were to validate the Precast Concrete Slab (PCS) and Fiberglass Mat (FGM) repairs for use with strategic airlift aircraft, to collect data on the performance of the two repair types under sustained airlift trafficking, to determine necessary modifications to the repair methods to support sustained airlift aircraft operations, and to provide additional data for the (TAXIG) HAVE BOUNCE Program.

DTIC

Runways; Aircraft Landing; Flight Operations

ASTRONAUTICS (GENERAL)

Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see categories 13 through 20. For extraterrestrial exploration, see 91 Lunar and Planetary Science and Exploration.

20030005107 Case Western Reserve Univ., Cleveland, OH USA

Experiments on Confined Turbulent Jets in Cross Flow Final Report

Kamotani, Yasuhiro, Case Western Reserve Univ., USA; Greber, Isaac, Case Western Reserve Univ., USA; March 1974; 77p; In English

Contract(s)/Grant(s): NGL-36-027-008

Report No.(s): NASA-CR-2392; NAS 1.26:2392; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Results are reported of experiments on the effects of an opposite wall on the characteristics of turbulent jets injected into a cross flow, for unheated and heated jets. Longitudinal and transverse distributions of velocity and temperature are presented for single and multiple circular jets, and trajectories are presented for two-dimensional jets. The opposite wall has relatively little effect on a single jet unless the ratio of jet to cross flow momentum flux is large enough for the jet to impinge on the opposite wall. For a row of jets aligned perpendicularly to the cross flow, the opposite wall exerts progressively larger influence as the spacing between jets decreases. Much of the effect of jet and wall proximity can be understood by considering the interaction of the vortex flow which is the major feature of the structure of a single jet in a cross flow. Smoke photographs are shown to elucidate some of the interaction patterns.

Author

Turbulent Jets; Two Dimensional Jets; Air Jets; Cross Flow

20030005715 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Contamination Measurements from the ESEX 26 kW Ammonia Arcjet Flight Experiment

Spanjers, Greg G.; Schilling, J. H.; Engelman, S. F.; Bromaghim, D. R.; Johnson, L. K.; Oct. 15, 1999; 24p; In English; Presented at the Intl Electric Propulsion Conference (26th) Held in Japan

Report No.(s): AD-A408116; AFRL-PR-ED-TP-FY99-019; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The USA Air Force Research Laboratory's Electric Propulsion Space Experiment (ESEX) was launched and operated in early 1999 in order to demonstrate the compatibility and readiness of a 30-kW class ammonia arcjet for satellite propulsion applications. As part of this flight, an array of on-board contamination sensors was used to assess the effect of the arcjet and other environments on the spacecraft. The sensors consisted of microbalances to measure material deposition, radiometers to assess material degradation due to thermal radiation, and solar cell segments to investigate solar array degradation. Over eight firings of the ESEX arcjet (and 33 min. 26 sec operating time), the following preliminary results are reported. The microbalances show no measurable

deposition from the arcjet, in agreement with predictions. The radiometer near the thruster, viewing the arcjet plume and body, experiences a change in the thermal properties of its coating from the firings. Radiometers with no view of the arcjet, or a view of only the plume, show no change. During firings, the solar cell segments, near the thruster, show decreasing open-circuit voltage; probably attributable to an additional electrical load provided by the plume plasma. The solar cells also exhibit a 3% decrease in non-firing, solar-illuminated short-circuit current over the eight arcjet firings, attributable to decreased solar transmission of the cover glass. However, no effects associated with the arcjet are observed on the spacecraft solar arrays. These data are in good agreement with model predictions, where available. In general, contamination effects are observed only on sensors near the thruster exhaust nozzle, a location unlikely to be used in an operational high-power electric propulsion system. No contamination effects are observed in the backplane of the thruster.

DTIC

Electric Propulsion; Arc Jet Engines; Spaceborne Experiments

15

LAUNCH VEHICLES AND LAUNCH OPERATIONS

Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also 18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power.

20030005683 Alabama Univ., Dept. of Electrical and Computer Engineering, Huntsville, AL USA

Improved Re-Configurable Sliding Mode Controller for ReUSAbLe Launch Vehicle of Second Generation Addressing Aerodynamic Surface Failures and Thrust Deficiencies *Final Report*

Shtessel, Yuri B., Alabama Univ., USA; 2002; 27p; In English

Contract(s)/Grant(s): NAG8-1787; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this report we present a time-varying sliding mode control (TV-SMC) technique for reUSAbLe launch vehicle (RLV) attitude control in ascent and entry flight phases. In ascent flight the guidance commands Euler roll, pitch and yaw angles, and in entry flight it commands the aerodynamic angles of bank, attack and sideslip. The controller employs a body rate inner loop and the attitude outer loop, which are separated in time-scale by the singular perturbation principle. The novelty of the TVSMC is that both the sliding surface and the boundary layer dynamics can be varied in real time using the PD-eigenvalue assignment technique. This salient feature is used to cope with control command saturation and integrator windup in the presence of severe disturbance or control effector failure, which enhances the robustness and fault tolerance of the controller. The TV-SMC is developed and tuned up for the X-33 sub-orbital technology demonstration vehicle in launch and re-entry modes. A variety of nominal, dispersion and failure scenarios have tested via high fidelity 6DOF simulations using MAVERIC/SLIM simulation software.

Author

Aerodynamics; Controllers; ReUSAbLe Launch Vehicles; Sliding; Thrust; Flight Control

20030005922 NASA Glenn Research Center, Cleveland, OH USA

Solid Hydrogen Experiments for Atomic Propellants: Particle Formation Energy and Imaging Analyses

Palaszewski, Bryan, NASA Glenn Research Center, USA; December 2002; 28p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 713-74-10

Report No.(s): NASA/TM-2002-211915; NAS 1.15:211915; E-13608; AIAA Paper 2002-4092; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

This paper presents particle formation energy balances and detailed analyses of the images from experiments that were conducted on the formation of solid hydrogen particles in liquid helium during the Phase II testing in 2001. Solid particles of hydrogen were frozen in liquid helium and observed with a video camera. The solid hydrogen particle sizes and the total mass of hydrogen particles were estimated. The particle formation efficiency is also estimated. Particle sizes from the Phase I testing in 1999 and the Phase II testing in 2001 were similar. Though the 2001 testing created similar particles sizes, many new particle formation phenomena were observed. These experiment image analyses are one of the first steps toward visually characterizing

these particles and it allows designers to understand what issues must be addressed in atomic propellant feed system designs for future aerospace vehicles.

Author

Imaging Techniques; Energy of Formation; Hydrogen; Solid Cryogenics; Elementary Particles; Particle Energy

17

SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information, see also 04 Aircraft Communications and Navigation and 32 Communications and Radar.

20030005660 Cornell Univ., Ithaca, NY USA

Design and Testing of Three-Axis Satellite Attitude Determination and Stabilization Systems That Are Based on Magnetic Sensing and Actuation *Final Report, 1 Jan. 2001-31 Aug. 2002*

Psiaki, Mark L.; Guelman, Moshe; Nov. 27, 2002; 55p; In English; Original contains color images; Prepared in collaboration with Technion Research and Development Foundation, Haifa, Israel

Contract(s)/Grant(s): F49620-01-1-0117

Report No.(s): AD-A408545; TR-2002.07; No Copyright; Avail: Defense Technical Information Center (DTIC)

Three-axis satellite attitude determination and active stabilization systems have been designed and tested using both flight experiments and simulation studies. These are being developed for use on low-Earth-orbiting name- satellites. Such satellites can be used as elements of constellations that implement synthetic aperture radar or that serve as nodes in a communications network. The research has addressed the problems of under-sensing and under-actuation that are present in magnetic-based systems. Magnetometer outputs are insensitive to rotation about the local Earth magnetic field, and magnetic torque coils cannot produce torque slump the field direction. A new attitude representation and a special globally-convergent extended Kalman filter have been used to solve the 3-axis attitude estimation problem. The efficacy of this system has been demonstrated using data from the missions, the Hubble Space Telescope and the Far-Ultraviolet Spectroscopic Explorer. Semi-active global 3-axis stabilization has been demonstrated using a simplified magnetometer output feedback control law in combination with weak passive stabilization of the axes. The passive stabilization can come from a very small momentum wheel or from a new aerodynamic system. The momentum-wheel-based concept has been successfully tested on the TechSat Gurwin II spacecraft.

DTIC

Artificial Satellites; Attitude Control; Control Theory; Feedback Control

20030006472 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

The USAF Electric Propulsion Research Program

Spanjers, Gregory G.; Birkan, Mitat; Lawrence, Timothy J.; Jul. 12, 2000; 11p; In English

Report No.(s): AD-A408448; AFRL-PR-ED-TP-2000-152; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

To provide enhanced satellite maneuvering capability at reduced cost, the USA Air Force (USAF) has developed a coordinated research program within the Air Force Office of Scientific Research (AFOSR), the Air Force Research Laboratory (AFRL), and the AFOSR European Office of Aerospace Research and Development (EOARD). Research direction for these efforts comes primarily from Air Force Space Command (AFSPC) in the form of a Strategic Master Plan (SMP). The SMP provides a 25-year AF plan, detailed in terms of near-term (2000-2007), mid-term (2008-2013), and far-term (2014-2025) development priorities. AFRL and AFOSR perform the mission analysis required to determine the optimal propulsion system for the AFSPC missions, and then develops research programs to develop the 4 technology needed to achieve these missions. EOARD interacts with AFRL and AFOSR to develop research at European laboratories that will directly feed into the AFOSR and AFRL research programs. Near-term missions are generally served through commercial contracts at the System Program Office (SPO) level.

DTIC

Electric Propulsion; Aerospace Systems; Research and Development; Defense Program

SPACECRAFT DESIGN, TESTING AND PERFORMANCE

Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems, see 54 Man/System Technology and Life Support. For related information, see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation and Safety.

20030006119 Eloret Corp., Sunnyvale, CA USA

Summary of ADTT Website Functionality and Features

Hawke, Veronica, Eloret Corp., USA; Duong, Trang, Eloret Corp., USA; Liang, Lawrence, Eloret Corp., USA; Gage, Peter, Eloret Corp., USA; December 2001; 134p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS2-00062

Report No.(s): NASA/CR-2001-211389; NAS 1.26:211389; AIT-08.01.2000; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report summarizes development of the ADTT web-based design environment by the ELORET team in 2000. The Advanced Design Technology Testbed had been in development for several years, with demonstration applications restricted to aerodynamic analyses of subsonic aircraft. The key changes achieved this year were improvements in Web-based accessibility, evaluation of collaborative visualization, remote invocation of geometry updates and performance analysis, and application to aerospace system analysis. Significant effort was also devoted to post-processing of data, chiefly through comparison of similar data for alternative vehicle concepts. Such comparison is an essential requirement for designers to make informed choices between alternatives. The next section of this report provides more discussion of the goals for ADTT development. Section 3 provides screen shots from a sample session in the ADTT environment, including Login and navigation to the project of interest, data inspection, analysis execution and output evaluation. The following section provides discussion of implementation details and recommendations for future development of the software and information technologies that provide the key functionality of the ADTT system. Section 5 discusses the integration architecture for the system, which links machines running different operating systems and provides unified access to data stored in distributed locations. Security is a significant issue for this system, especially for remote access to NAS machines, so Section 6 discusses several architectural considerations with respect to security. Additional details of some aspects of ADTT development are included in Appendices.

Author

Websites; Aircraft Design

20030006120 NASA Langley Research Center, Hampton, VA USA

Control Surface and Afterbody Experimental Aeroheating for a Proposed Mars Smart Lander Aeroshell

Liechty, Derek S., NASA Langley Research Center, USA; Hollis, Brian R., NASA Langley Research Center, USA; Edquist, Karl T., NASA Langley Research Center, USA; [2002]; 17p; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4506; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Several configurations, having a Viking aeroshell heritage and providing lift-to-drag required for precision landing, have been considered for a proposed Mars Smart Lander. An experimental aeroheating investigation of two configurations, one having a blended tab and the other a blended shelf control surface, has been conducted at the NASA Langley Research Center in the 20-Inch Mach 6 Air Tunnel to assess heating levels on these control surfaces and their effects on afterbody heating. The proposed Mars Smart Lander concept is to be attached through its aeroshell to the main spacecraft bus, thereby producing cavities in the forebody heat shield upon separation prior to entry into the Martian atmosphere. The effects these cavities will have on the heating levels experienced by the control surface and the afterbody were also examined. The effects of Reynolds number, angle-of-attack, and cavity location on aeroheating levels and distributions were determined and are presented. At the highest angle-of-attack, blended tab heating was increased due to transitional reattachment of the separated shear layer. The placement of cavities downstream of the control surface greatly influenced aeroheating levels and distributions. Forebody heat shield cavities had no effect on afterbody heating and the presence of control surfaces decreased leeward afterbody heating slightly.

Author

Control Surfaces; Wind Tunnel Tests; Aeroshells; Aerodynamic Heating; Mars Landing

20030006739 NASA Langley Research Center, Hampton, VA USA

Tactical Defenses Against Systematic Variation in Wind Tunnel Testing

DeLoach, Richard, NASA Langley Research Center, USA; [2002]; 42p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-0885; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

This paper examines the role of unexplained systematic variation on the reproducibility of wind tunnel test results. Sample means and variances estimated in the presence of systematic variations are shown to be susceptible to bias errors that are generally non-reproducible functions of those variations. Unless certain precautions are taken to defend against the effects of systematic variation, it is shown that experimental results can be difficult to duplicate and of dubious value for predicting system response with the highest precision or accuracy that could otherwise be achieved. Results are reported from an experiment designed to estimate how frequently systematic variations are in play in a representative wind tunnel experiment. These results suggest that significant systematic variation occurs frequently enough to cast doubts on the common assumption that sample observations can be reliably assumed to be independent. The consequences of ignoring correlation among observations induced by systematic variation are considered in some detail. Experimental tactics are described that defend against systematic variation. The effectiveness of these tactics is illustrated through computational experiments and real wind tunnel experimental results. Some tutorial information describes how to analyze experimental results that have been obtained using such quality assurance tactics.

Author

Wind Tunnel Tests; Tactics; Quality Control; Errors; Accident Prevention

19

SPACECRAFT INSTRUMENTATION AND ASTRIONICS

Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information, see also 06 Aircraft Instrumentation and Avionics; For spaceborne instruments not integral to the vehicle itself see 35 Instrumentation and Photography; For spaceborne telescopes and other astronomical instruments see 89 Astronomy, Instrumentation and Photography; For spaceborne telescopes and other astronomical instruments see 89 Astronomy.

20030006687 NASA Langley Research Center, Hampton, VA USA

Thermal Analysis and Correlation of the Mars Odyssey Spacecraft's Solar Array During Aerobraking Operations

Dec, John A., NASA Langley Research Center, USA; Gasbarre, Joseph F., NASA Langley Research Center, USA; George, Benjamin E., Department of the Air Force, USA; [2002]; 11p; In English; AIAA/AAS Astrodynamics Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations Report No.(s): AIAA Paper 2002-4536; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The Mars Odyssey spacecraft made use of multipass aerobraking to gradually reduce its orbit period from a highly elliptical insertion orbit to its final science orbit. Aerobraking operations provided an opportunity to apply advanced thermal analysis techniques to predict the temperature of the spacecraft's solar array for each drag pass. Odyssey telemetry data was used to correlate the thermal model. The thermal analysis was tightly coupled to the flight mechanics, aerodynamics, and atmospheric modeling efforts being performed during operations. Specifically, the thermal analysis predictions required a calculation of the spacecraft's velocity relative to the atmosphere, a prediction of the atmospheric density, and a prediction of the heat transfer coefficients due to aerodynamic heating. Temperature correlations were performed by comparing predicted temperatures of the thermocouples to the actual thermocouple readings from the spacecraft. Time histories of the spacecraft relative velocity, atmospheric density, and heat transfer coefficients, calculated using flight accelerometer and quaternion data, were used to calculate the aerodynamic heating. During aerobraking operations, the correlations were used to continually update the thermal model, thus increasing confidence in the predictions. This paper describes the thermal analysis that was performed and presents the correlations to the flight data.

Author

Thermal Analysis; Correlation; 2001 Mars Odyssey; Solar Arrays; Heat Transfer Coefficients; Aerodynamic Heating

SPACECRAFT PROPULSION AND POWER

Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also 07 Aircraft Propulsion and Power; 28 Propellants and Fuels; 15 Launch Vehicles and Launch Operations; and 44 Energy Production and Conversion.

20030005658 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

AFRL MicroPPT Development for Small Spacecraft Propulsion

White, David; Schilling, John H.; Bushman, Stewart; Spanjers, Gregory G.; Bromaghim, Daron K.R.; May 02, 2002; 16p; In English; Prepared in collaboration with W.E. Research, Rosamond, CA

Contract(s)/Grant(s): AF Proj. 1011

Report No.(s): AD-A408550; AFRL-PR-ED-TP-2002-094; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A class of miniaturized pulsed plasma thrusters (PPT), known as MicroPPTs, is currently in development at the Air Force Research Laboratory. The MicroPPTs use a surface discharge across solid Teflon(TM) propellant to provide precise impulse bits in the 10 microN-s range. In the near term, these thrusters can provide propulsive attitude control on 150-kg-class spacecraft using 1/5th the dry mass of conventional torque rods and reaction wheels. Eventually these thrusters are designed for primary and attitude control propulsion on future 25-kg class spacecraft envisioned for such missions as formation flying sparse aperture arrays for space-based surveillance, on-orbit satellite servicing, and space control. A synopsis of the status of the thruster is presented, discussing development, lifetime, performance, and environmental testing.

DTIC

Plasma Engines; Spacecraft Propulsion; Pulsed Plasma Thrusters

20030005661 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Electromagnetic Effects in the Near Field Plume Exhaust of a Micro-Pulsed Plasma Thruster

Keidar, Michael; Boyd, Iain D.; Antonsen, Eric; Spanjers, Gregory G.; Jun. 12, 2002; 29p; In English

Contract(s)/Grant(s): AF Proj. 1011

Report No.(s): AD-A408544; AFRL-PR-ED-TP-2002-139; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this work we present a model of the near field plasma plume of a Pulsed Plasma Thruster (PPT). As a working example we consider a micro-PPT developed at the Air Force Research Laboratory. This is a miniaturized design of the axisymmetric PPT with a thrust in the 10 micro-N range that utilizes Teflon(Trademark(sup Trademark)) as a propellant. The plasma plume is simulated using a hybrid fluid-PIC-DSMC approach. The plasma plume model is combined with Teflon(Trademark) ablation and plasma generation models that provide boundary conditions for the plume. This approach provides a consistent description of the plasma flow from the surface into the near plume. The magnetic field diffusion into the plume region is also considered and plasma acceleration by the electromagnetic mechanism is studied. Teflon(Trademark) ablation and plasma generation analyses show that the Teflon(Trademark) surface temperature and plasma parameters are strongly non-uniform in the radial direction. The plasma density near the propellant surface peaks at about $10(\exp 24)/\text{cu m}$ in the middle of the propellant face while the electron temperature peaks at about 4 eV near the electrodes. The plume simulation shows that a dense plasma focus is developed at a few millimeters from the thruster exit plane at the axis. This plasma focus exists during the entire pulse, but the plasma density in the focus decreases from about $2 \times 10(\exp 22)/\text{cu m}$ at the beginning of the pulse down to $0.3 \times 10(\exp 22)/\text{cu m}$ at 5 microsec. The velocity phase is centered at about 20 km/s in the axial direction. At later stages of the pulse there are two ion populations with positive and negative radial velocity. Electron densities predicted by the plume model are compared with near field measurements using a Herriot Cell technique and very good agreement is obtained.

DTIC

Electric Propulsion; Magnetohydrodynamic Flow; Computerized Simulation; Boundary Conditions

20030005662 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Examination of a Hall Thruster Start Transient

Hargus, W. A., Jr.; Pote, B.; Jun. 13, 2002; 9p; In English

Contract(s)/Grant(s): AF Proj. 1011

Report No.(s): AD-A408543; AFRL-PR-ED-TP-2002-143; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We discuss the appearance of an anode current transient which persists a maximum of 500 seconds and results in a 50% increase in the anode current during initial start-up following exposure to ambient laboratory conditions. The anode current transient is characterized by 18 kHz main discharge on/off behavior. This contrasts with the steady state behavior of a strong DC component overlaid with a low amplitude 25 kHz component. Conduction through the radial magnetic field appears to be modified

during the transient period. The main discharge chamber is determined to be the source of this behavior. The anode current transient appears to be a result of water absorption on the surface layer of the boron nitride insulator. We speculate as to the connection between the absorption of water and the anode current transient. The modification of the secondary electron emission coefficient could affect near wall conductivity and produce the measured effects. The introduction of hydrogen from dissociated water could also produce these enhanced oscillations.

DTIC

Electric Propulsion; Hall Thrusters

20030005663 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Solar Technology

McFall, Keith; Dec. 06, 1999; 19p; In English; Pres: 49th JANNAF Propulsion Meeting 14-16 Dec 1999, Tucson, AZ

Report No.(s): AD-A408541; AFRL-PR-ED-TP-1999-0242; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The viewgraphs/presentation slides for Solar Technology are presented.

DTIC

Chutes; Propulsion System Configurations

20030005728 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Comparative Lightcraft Impulse Measurements

Mead, Franklin B., Jr.; Larson, C. W.; Kalliomaa, Wayne M.; Nov. 19, 2001; 4p; In English; Laser Ablation 2002, 21 Apr. 2002, Taos, NM, USA; Prepared in collaboration with German Aerospace Center (DLR), Inst. of Technical Physics, Stuttgart, Germany
Contract(s)/Grant(s): AF Proj. 4847

Report No.(s): AD-A408563; AFRL-PR-ED-AB-2001-231; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The impulse coupling coefficients, cm, of two radically different laser propulsion thruster concepts (lightcrafts), each 10 cm in diameter, have been measured under equal conditions using two different test stands. Lightcraft one is of toroidal shape and was provided by the U.S. Air Force Research Laboratory (AFRL). A lightcraft of this shape and size has been used in free flight experiments at White Sands Missile Range, NM. Lightcraft two is bell (e.g., a paraboloid) shaped. With this type of lightcraft, the DLR previously conducted preliminary performance experiments, including vertical wire-bound flights in the laboratory. Both test stands were of the pendulum type. Test stand one was provided by the AFRL, and was a "rigid" pendulum, allowing motion in only one degree of freedom. The second test stand, a DLR design, suspended the lightcraft by thin wires and corresponded to a nearly perfect pendulum in the mathematical sense. All experiments employed the DLR electric-beam sustained, pulsed, CO(2) laser with pulse energies up to 400 J. The laser was operated with two configurations: 1) a stable resonator (flat beam profile); and, 2) an unstable resonator (ring shaped beam profile). All experiments were carried out in the open laboratory environment. Propellant, therefore, was either the surrounding air alone, or Delrin as an added solid propellant. For lightcraft one the cm value increased by a factor of three (450 N/MW) by adding Delrin. With lightcraft two, a comparable cm value of 590 N/MW was obtained. This corresponded to a Delrin loss of 60-SO ug/J. Results of cm as a function of the laser pulse energy for the various experimental conditions will be presented.

DTIC

Test Stands; Pulsed Lasers; Laser Propulsion; Thrusters

20030005731 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

A Colloid Engine Accelerator Concept

Kirtley, D.; Fife, J. M.; Jun. 20, 2002; 6p; In English; Presented at the AIAA JPC held in Indianapolis, IN on 8-10 July 2002

Report No.(s): AD-A408555; AFRL-PR-ED-TP-2002-162; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A concept for a colloid engine with an electrodynamic linear accelerator is described. The charged particle source is a standard colloid engine with an extractor voltage that has an AC component. Downstream of the extractor, a series of accelerator gates are biased alternately with an AC voltage such that the charged droplets tend to remain in regions with positive electric fields. Since the droplet speed varies with their position in the accelerator, and the alternating voltage is of a constant frequency, the gate spacing must change with length. This variation in gate spacing may be determined analytically. This paper attempts to predict some of the potential performance advantages and disadvantages of such an engine. Also, design issues are explored, with special attention to potential problem areas.

DTIC

Electrodynamics; Linear Accelerators; Electric Potential

20030005845 NASA Marshall Space Flight Center, Huntsville, AL USA

Understanding and Resolution of the Block 2 SSME, STS-104 Engine Shutdown Pressure Surge In-Flight Anomaly

Greene, William D., NASA Marshall Space Flight Center, USA; Kynard, Michael H., NASA Marshall Space Flight Center, USA; Jul. 07, 2002; 15p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations Report No.(s): AIAA Paper 2002-3581; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

STS-104, launched July 2001, marked the first flight of a single Block 2 Space Shuttle Main Engine (SSME). This new configuration of the SSME is the culmination of well over a decade of gradual engine system upgrades. The launch and mission were a success. However, in the process of post-launch data analysis a Main Propulsion System (MPS) anomaly was noted and tied directly to the shutdown of the Block 2 SSME. An investigation into this anomaly was organized across NASA facilities and across the various hardware component contractors. This paper is a very brief summary of the eventual understanding of the root causes of the anomaly and the process whereby an appropriate mitigation action was proposed. An analytical model of the High Pressure Fuel Pump (HPFP) and the low pressure fuel system of the SSME is presented to facilitate the presentation of this summary. The proposed mitigation action is discussed and, with the launch of STS-108 in November 2001, successfully demonstrated under flight conditions.

Author

Anomalies; Flight Conditions; Fuel Systems; Mathematical Models; Shutdowns; Space Shuttle Main Engine

20030005932 Universidad Politecnica de Madrid, Escuela Tecnica Superior de Ingenieros de Caminos, Madrid, Spain

Analysis of the Plasma Response in a Hall Thruster Final Report, 13 Aug. 2001-13 Aug 2002

Ahedo, Eduardo; Gallardo, Juan M.; Parra, Felix I.; Aug. 26, 2002; 113p; In English

Contract(s)/Grant(s): F61775-01-W-E070

Report No.(s): AD-A408340; EOARD-SPC-01-4070; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This report investigates 1 dimensional and 2 dimensional hall effect thruster models to better understand the following physics related issues: radial structure of the plasma, lateral wall effects, physics of the subsonic region, no near-total ionization regimes, effects of secondary electron emission from the walls, and reduction of the growth rate of self oscillations.

DTIC

Hall Thrusters; Electric Propulsion

20030005939 Thiokol Propulsion, Brigham City, UT USA

Evaluating Solid Boost Demonstrator Motor Specific Impulse Performance

Ahmad, Rashid A.; Laubacher, Brian; Feb. 2001; 4p; In English; at AIAA/ASME/SAE/ASEE Joint Propulsion Conf. Held in Salt Lake City, UT, 8-11 Jul 2001

Contract(s)/Grant(s): F04611-99-C-0021; AF Proj. 4373

Report No.(s): AD-A408382; AFRL-PR-ED-AB-2001-039; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The Integrated High Payoff Rocket Propulsion Technology (IHRPT) Phase I solid Boost Demonstrator (Boost Demo) motor was fabricated as the Phase I demonstration of technologies from the IHRPT program. This motor incorporates new technologies in an attempt to increase delivered performance compared with the IHRPT Baseline motor. The IHRPT Baseline motor and Boost Demo nozzle motor aft and nozzle contours are compared.

DTIC

Booster Rocket Engines; Performance Tests; Solid Propellant Rocket Engines; Specific Impulse

20030005940 ATK-Thiokol Propulsion, Brigham City, UT USA

IHRPT Phase I Solid Boost Demonstrator: A Success Story

Glaittli, Steven R.; Jun. 2001; 8p; In English; Pub. in proceedings of 37th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit. Held in Salt Lake City, UT, 8-11 Jul 2001

Contract(s)/Grant(s): F04611-99-C-0021; AF Proj. 4373

Report No.(s): AD-A408384; AFRL-PR-ED-TP-2001-125; AIAA Paper 2001-3451; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The integrated High-Payoff Rocket Propulsion Technology or IHRPT program seeks to double the launch capability of the USA by the year 2010. The program is organized into three phases, with a technology demonstrator at the end of each phase. The IHRPT Phase I Solid Boost Demonstrator Program is presented. Materials and processing technologies developed under the IHRPT program and on other contracted technology and privately funded programs were combined into one full-scale booster

demonstrator culminating six years of new technology work. New materials and processes were used in all components of the demonstration motor to achieve the cost and performance goals identified for the Phase I Boost & Orbit Transfer Propulsion mission area in the IHPRPT program. New materials utilized in the motor included low cost high performance carbon fibers in the composite case energetic ingredients in the propellant. net molded structural parts in the nozzle. and an all-new electromechanical Thrust Vector Actuation (TVA) system. The demonstrator was successfully static tested on 16 November 2000. The static test has been heralded as a success by government and industry observers alike.

DTIC

Booster Rocket Engines; Solid Propellant Rocket Engines; Static Tests

20030005941 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

A Status Report of the X-50LR Program: A Laser Propulsion Program

Mead, Frank B., Jr.; Larson, C. W.; Kalliomaa, Wayne M.; Oct. 01, 2001; 4p; In English; Pres. at AIAA Plasmadynamics and Lasers Conference (33rd). Held in Maui, HI, 20-23 May 2002

Contract(s)/Grant(s): AF Proj. 4847

Report No.(s): AD-A408385; AFRL-PR-ED-AB-2001-196; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

In 1996, the Air Force Research Lab's Propulsion Division at Edwards AFB initiated a program that had as its main objective to launch a laser-propelled vehicle into a suborbital trajectory within a period of 5 years in order to demonstrate the concept and its attractive features. The concept was to be a nanosatellite in which the laser propulsion engine and satellite hardware were intimately shared. This concept was based upon a 1989 design developed at Rensselaer Polytechnic Institute under a Space Defense Initiative Office laser propulsion program. The forebody aeroshell had been designed to act as an external compression surface (i.e. the airbreathing engine inlet). The afterbody served a dual function as a primary receptive optic (parabolic mirror) for the laser beam and as an external expansion surface (plug nozzle). The primary thrust structure was the centrally located annular shroud. The shroud provided air through inlets and acts as a energy absorption chamber for plasma formation. In the rocket mode, the air inlets were closed, and the afterbody and shroud combined to form the rocket thrust chamber and plug ('aerospike-type') nozzle. The fully-scale vehicle was 1.4 meters in diameter with a dry mass of 120 kg. Fully fueled, this vehicle would have an initial mass of about 240 kg (i.e., a mass fraction of 0.5), and would be launched into orbit with a 100 megawatt-class infrared ground-based laser (GBL). This laser propelled vehicle would be a single-stage-to-orbit (i.e., airbreathing only to M=5 and 30 km; a laser thermal rocket, using liquid propellants, at higher altitudes and in space) using a combined-cycle pulsed detonation engine. Once in space, the Lightcraft was to use its one meter diameter optical system to provide, for example, Earth surveys from low Earth orbit with 8-15 cm resolution in the visible light frequencies. Such a device was simple, reliable, safe, environmentally clean, and could have a very high all azimuth on demand launch rate.

DTIC

Laser Propulsion; Nanosatellites; Spaceborne Lasers; Laser Beams

20030006268 NASA Marshall Space Flight Center, Huntsville, AL USA

Trajectories for High Specific Impulse High Specific Power Deep Space Exploration

Polsgrove, T., NASA Marshall Space Flight Center, USA; Adams, R. B., NASA Marshall Space Flight Center, USA; Jul. 10, 2002; 10p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4233; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Preliminary results are presented for two methods to approximate the mission performance of high specific impulse high specific power vehicles. The first method is based on an analytical approximation derived by Williams and Shepherd and can be used to approximate mission performance to outer planets and interstellar space. The second method is based on a parametric analysis of trajectories created using the well known trajectory optimization code, VARITOP. This parametric analysis allows the reader to approximate payload ratios and optimal power requirements for both one-way and round-trip missions. While this second method only addresses missions to and from Jupiter, future work will encompass all of the outer planet destinations and some interstellar precursor missions.

Author

Space Missions; Specific Impulse; Spacecraft Trajectories

20030006270 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Micropropulsion Options for the TechSat21 Space-Based Radar Flight

Schilling, John H.; Spres, Ronald A.; Spanjers, Gregory G.; Nov. 08, 1999; 40p; In English

Report No.(s): AD-A408508; AFRL-PR-ED-TP-FY99-0046; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An assessment of current micropropulsion concepts and their applicability to a new Air Force mission called TechSat21 is given. The goal of TechSat21 is to demonstrate the critical technologies for a formation-flying constellation of satellites that will perform space based radar. The propulsion system must accomplish an initial ascent, 10 year stationkeeping and drag makeup, and end-of-life deorbit. Major constraints on the propulsion system are total mass, minimum impulse bit, and contamination or other interference with the constellation. Due to its technical maturity, high performance, ease of integration, and potential for improved performance over the next couple of years, the recommended propulsion system is the conventional Pulsed Plasma Thruster (PPT) for primary propulsion and the Micro-PPT for stationkeeping. A low-power Hall thruster (-200 W) for primary propulsion and Micro-PPT for stationkeeping is also a strong candidate. Electrodynamic tethers for the deorbits offer a means for further reducing the propulsion mass, albeit at the expense of increased developmental and integration costs. If significant developmental risk is acceptable, the Micro Field Ionization Thruster (MFIT) offers the lowest propulsion system mass, however it is not expected to be available in the timeframe required for the TechSat21 mission.

DTIC

Radar; Spacecraft Propulsion

20030006273 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Swirl Coaxial Injector Development. Part I: Test Results

Muss, J. A.; Johnson, C. W.; Cohn, R. K.; Strakey, P. A.; Bates, R. W.; Mar. 22, 2002; 16p; In English; Prepared in collaboration with Sierra Engineering, Inc., Carson City, NV

Contract(s)/Grant(s): F04611-01-C-0010

Report No.(s): AD-A408502; AFRL-PR-ED-TP-2002-069; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Sierra Engineering, in conjunction with the Air Force Research Laboratory Propulsion Directorate, has undertaken a program to develop a gas-centered, swirl coaxial injector. This injector design will be used in the multi-element Advanced Fuels Tester (AFT) engine to test a variety of hydrocarbon propellants. As part of this program, a design methodology is being developed which will be applicable to future injector design efforts. The methodology combines cold flow data, acquired in the AFRL High Pressure Injector Flow facility, uni-element hot fire data, collected in AFRL Test Cell EC-1, and a computational effort conducted at University of Alabama-Birmingham, to identify key design features and sensitivities. Results from the computational effort will be presented in the Part II companion paper (9). Three different gas-centered swirl coaxial element concepts were studied: a converging design, a diverging design, and a pre-filming design. The cold flow experiments demonstrated that all three classes of elements produced an extremely dense, solid cone spray, with the highest mass density in the center. The atomization of all of these injectors was excellent, producing mean drop sizes 1/3 to 1/4 of that typically measured for shear coaxial elements operating under similar conditions. Uni-element hot fire testing of these elements has begun, but the elements have not yet been tested at the design operating conditions. Preliminary low chamber pressure test results show the converging design performs better than the pre-filming and diverging design. Uni-element C* efficiencies in excess of 90% have been measured over a wide-range of mixture ratios.

DTIC

Injectors; Coaxial Cables

20030006277 Pratt and Whitney Aircraft, Liquid Space Propulsion, West Palm Beach, FL USA

Fabrication and Test of an Advanced Expander Combustor

Jennings, T.; Fentress, S.; Lyda, R.; Jun. 2000; 10p; In English; at AIAA/ASME/SAE/ASEE Joint Propulsion Conf. and Exhibit, (36th). Held in Huntsville, AL, 17-19 Jul 2000. AIAA paper 2000-3776

Contract(s)/Grant(s): F04611-95-C-0123; AF Proj. 1011

Report No.(s): AD-A408495; AFRL-PR-ED-TP-2000-127; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper discusses fabrication and test of an advanced expander combustion chamber for a 50,000 pound (222.4 kN) thrust Upper Stage Expander Cycle Engine. The chamber is being developed by Pratt & Whitney Liquid Space Propulsion under contract for the USA Air Force Research Laboratory (AFRL) to support the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) initiative. The Advanced Expander Combustor is designed to provide increased heat pick-up to the coolant and improved system thrust to weight, increased specific impulse, and increased reliability.

DTIC

Combustion Chambers; Liquid Propellant Rocket Engines

20030006278 Pratt and Whitney Aircraft, Liquid Space Propulsion, West Palm Beach, FL USA

Design and Development of an Advanced Expander Combustor

Peery, S.; Minick, A.; Jul. 1998; 13p; In English; at AIAA/ASME/SAE/ASEE Joint Propulsion Conf. and Exhibit (34th). Held in Cleveland, OH, 13-15 Jul 1998. AIAA paper 98-3675

Contract(s)/Grant(s): F04611-95-C-0123; AF Proj. 1011

Report No.(s): AD-A408494; AFRL-PR-ED-TP-1998-131; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper discusses design and development of an advanced expander combustion chamber for a 50,000 pound (222.4 kN) thrust Upper Stage Expander Cycle Engine being developed by Pratt & Whitney Liquid Space Propulsion under contract for the USA Air Force Research Laboratory (AFRL) to support the Integrated High Payoff Rocket Technology (IHPRPT) program. The Advanced Expander Combustor is designed to provide increased heat pick-up to the coolant and improved system thrust to weight, increased specific impulse, and increased reliability. These benefits will be accomplished and demonstrated through design, development, and test of this high heat flux, compact thrust chamber capable of supporting a chamber pressure of 1375 psia (97 kg/sq cm) in an expander cycle configuration.

DTIC

Combustion Chambers; Liquid Propellant Rocket Engines

20030006279 Pratt and Whitney Aircraft, Liquid Space Propulsion, West Palm Beach, FL USA

Development and Test of an Advanced Expander Combustor

Jennings, T.; Fentress, S.; Peery, S.; Minick, A.; Jun. 24, 1999; 13p; In English; at AIAA/ASME/SAE/ASEE Joint Propulsion Conf. and Exhibit (35th). Held in Los Angeles, CA, 20-24 Jun 1999. AIAA paper 99-2599

Contract(s)/Grant(s): F04611-95-C-0123; AF Proj. 1011

Report No.(s): AD-A408493; AFRL-PR-ED-TP-1999-0148; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper discusses development and test of an advanced expander combustion chamber for a 50,000 pound (222.4 kN) thrust Upper Stage Expander Cycle Engine. The chamber is being developed by Pratt & Whitney Liquid Space Propulsion under contract for the USA Air Force Research Laboratory (AFRL) to support the Integrated High Payoff Rocket Propulsion Technology (IHPRPT) program. The Advanced Expander Combustor is designed to provide increased heat pick-up to the coolant and improved system thrust to weight, increased specific impulse, and increased reliability. These benefits will be accomplished and demonstrated through design, development, and test of this high heat flux, compact thrust chamber capable of supporting a chamber pressure of 1375 psia (97 kg/sq cm) in an expander cycle configuration.

DTIC

Combustion Chambers; Liquid Propellant Rocket Engines

20030006280 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Solar Thermal : Solar Electric Propulsion Hybrid Orbit Transfer Analysis

McFall, Keith A.; Jul. 2000; 12p; In English; at AIAA/ASME/SAE/ASEE Joint Propulsion Conf. and Exhibit (36th). Held at Huntsville, AL, 16-19 Jul 2000. AIAA paper AIAA-00-3859

Contract(s)/Grant(s): AF Proj. 1011

Report No.(s): AD-A408492; AFRL-PR-ED-TP-2000-147; AFRL-PR-ED-TP-2000-147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This effort examined the payoffs associated with the joint application of solar thermal propulsion (STP) and electric propulsion (EP) for orbit raising. The combined use of STP (800 second specific impulse) and EP (1800 second specific impulse) for a single orbit transfer mission is motivated by the desire to leverage the higher thrust of STP with the higher specific impulse of EP to maximize mission capability. The primary objectives of this analysis were to quantify the payload, mission duration, and hydrogen propellant to payload mass ratio for a range of combined STP and EP orbit transfer missions to geosynchronous Earth orbit (GEO), and contrast them to results for STP only. For STP, the hydrogen propellant to payload mass ratio is of particular interest due to payload fairing size constraints and the relatively low density of liquid hydrogen, which limit the mass of the STP propellant, and therefore the amount of payload that can be delivered. The results of the analysis include an 18% payload improvement associated with STP-EP hybrid propulsion over STP alone. The trip time needed for the STP-EP transfer varied from 101 to 143 days, compared to 41 days for the Solar only case. In addition, the amount of hydrogen propellant needed to accomplish the orbit raising to GEO per unit mass of payload decreased by 29% when the Solar Thermal - Solar Electric hybrid was used. While comprehensive comparisons of STP-EP to chemical propulsion (CP) only and to CP with EP orbit topping were also of interest, they were beyond the scope of this effort. However, a comparison of reference missions was performed. In comparison

to the reference CP (328 second specific impulse) and CP-EP missions the STP-EP system provided 67% and 39% payload increases. respectively. The trip time for the CP-EP cases varied from 55 to 106 days.

DTIC

Solar Energy; Spacecraft Propulsion

20030006283 California State Univ., Los Angeles, CA USA

Conceptual Design Study of a Solar Concentrator/Support Structure: A Three Dimensional Finite Element Model

Purasinghe, R.; Jan. 1993; 14p; In English

Report No.(s): AD-A408489; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Under the space environment the paraboloid solar concentrators and support structures can deform and hence the focal point of the concentrators can diffuse. If this diffusion is large, energy will not concentrate on the thruster as desired. This paper addresses this aspect of pointing and accuracy analysis of solar concentrators, due to equivalent thrust loads. The previous studies were limited to the concentrator system being modeled with a simplified finite element model that includes only the support struts and torus. The torus model was made up of several equal length beams. The simple model did not contain the paraboloid reflector, and assumes the reflector does not affect the deformation of the torus. In the present study the inflated parabolic reflector is included in the model. The results demonstrate the non uniform displacements on the reflector that confirms the reflector's potato chipping effect.

DTIC

Finite Element Method; Stiffness; Solar Collectors

20030006284 Raytheon STX Corp., Moffett Field, CA USA

Basic Research in Electric Propulsion. Part I: Pulsed Plasma Thruster Propellant Efficiency and Contamination. Part II: Arcjet Remote Plume Measurement and Hydrogen Density Interim Report, 28 Jul. 1992-28 Feb. 1997

Pobst, J. A.; Spanjers, G. G.; Wysong, I. J.; Malak, J. B.; Feb. 2002; 54p; In English; Original contains color images

Contract(s)/Grant(s): F04611-93-C-0005; AF Proj. 3058

Report No.(s): AD-A408488; AFRL/PRS-TR-97-3027; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Pulsed Plasma Thrusters (PPT) have been the major technology under investigation for the Small Satellite Electric Propulsion Thruster Research program. Arcjet technology is also under investigation with Electric Propulsion Space Experiment Optical Signature experiments underway and Multiphoton Laser Induced Fluorescence Measurements of Ground State Atomic Hydrogen have been performed in an arcjet plume. At present PPTs are being tested in the laboratory environment with investigations under way to determine exact inefficiency mechanisms that can be corrected. This work has already identified previously unknown physical behavior in the PPT. The Electric Propulsion Space Experiment is a flight demonstration of a 30 kW ammonia arcjet propulsion system. Optical measurements of the arcjet plume were performed using on-board optical equipment ground observatories and other space platforms. Low power arcjet technology provided definitive work on atomic species plume concentrations in low power hydrogen arcjet plumes. This work applied a flame diagnostic Multiphoton Laser Induced Fluorescence to the excited-state plasma environment to investigate concentration levels of atomic ground-state hydrogen.

DTIC

Electric Propulsion; Aerospace Environments

20030006319 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Resonant Operation of a Micro-Newton Thrust Stand

Adkison, Paul B.; Dulligan, Michael J.; Jun. 06, 2002; 10p; In English

Report No.(s): AD-A408511; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A computer automated technique suitable for evaluating micro pulsed plasma thruster (uPPT) performance has been constructed and validated in the micro-Newton (micro N) force range. A swinging gate pendulum architecture oscillates with an 3 second period. Force is applied resonantly with oscillation each half period. The calibration method utilizes an electromagnet to pick up and drop masses to apply a known force in the same resonant fashion as thruster operation. The resulting equilibrium amplitudes are linearly proportional to the applied force with an intercept near zero. Thrust measurements are insensitive to short term random vibrational noise because of the resonant operation and are insensitive to long term drift because the amplitude measurements are relative, rather than absolute.

DTIC

Automation; Plasma Engines; Thrusters

20030006320 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

The USAF Electronic Propulsion Research Program

Spores, Ronald A.; Birkan, Mitat; Jun. 20, 2002; 15p; In English

Report No.(s): AD-A408510; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

All overview of current electric propulsion research and development efforts within the USA Air Force is presented. The Air Force supports electric propulsion primarily through the Air Force Office of Scientific Research (AFOSR), the Air Force Research Laboratory (AFRL) and the AFOSR European Office of Aerospace Research and Development (BOARD). Overall direction for the programs comes from Air Force Space Command (AFSPC), with AFRL mission analysis used to define specific technological advances needed to meet AFSPC mission priorities. AFOSR funds basic research in electric propulsion throughout the country in both academia and industry. The AFRL Propulsion Directorate conducts electric propulsion efforts in basic research, engineering development, and space flight experiments. BOARD supports research at foreign laboratories that feeds directly into AFOSR and AFRL research programs. Current research efforts fall into 3 main categories defined loosely by the thruster power level. All three agencies are conducting research at the low-power regime (P less than 200 W), in support of emerging USAF microsatellite missions. Efforts in the mid-power range (500 W to 5 kW) is being shifted from research and development to thruster/spacecraft integration issues. The high power regime (P greater than 30 kW) is realizing increased emphasis.

DTIC

Electric Propulsion; Military Technology; Research and Development

20030006444 NASA Glenn Research Center, Cleveland, OH USA

Photovoltaic Power for Future NASA Missions

Landis, Geoffrey, NASA Glenn Research Center, USA; Bailey, Sheila G., NASA Glenn Research Center, USA; [2002]; 11p; In English; AIAA 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): YOK3948

Report No.(s): AIAA Paper 2002-0718; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Recent advances in crystalline solar cell technology are reviewed. Dual-junction and triple-junction solar cells are presently available from several U. S. vendors. Commercially available triple-junction cells consisting of GaInP, GaAs, and Ge layers can produce up to 27% conversion efficiency in production lots. Technology status and performance figures of merit for currently available photovoltaic arrays are discussed. Three specific NASA mission applications are discussed in detail: Mars surface applications, high temperature solar cell applications, and integrated microelectronic power supplies for nanosatellites.

Author

Photovoltaic Cells; Space Missions; Gallium Arsenides

20030006451 NASA Marshall Space Flight Center, Huntsville, AL USA

Simplified Analysis of Pulse Detonation Rocket Engine Blowdown Gasdynamics and Performance

Morris, C. I., NASA Marshall Space Flight Center, USA; [2002]; 23p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-3715; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Pulse detonation rocket engines (PDREs) offer potential performance improvements over conventional designs, but represent a challenging modelling task. A simplified model for an idealized, straight-tube, single-shot PDRE blowdown process and thrust determination is described and implemented. In order to form an assessment of the accuracy of the model, the flowfield time history is compared to experimental data from Stanford University. Parametric Studies of the effect of mixture stoichiometry, initial fill temperature, and blowdown pressure ratio on the performance of a PDRE are performed using the model. PDRE performance is also compared with a conventional steady-state rocket engine over a range of pressure ratios using similar gasdynamic assumptions.

Author

Pulse Detonation Engines; Gas Dynamics; Thrust; Flow Distribution

CHEMISTRY AND MATERIALS (GENERAL)

Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see categories 24 through 29. For astrochemistry see category 90 Astrophysics.

20030006691 Lawrence Livermore National Lab., Livermore, CA USA

Applications of Electro-Osmotic Transport in the Processing of Textiles

Cooper, J. F.; Krueger, R.; Hopper, R.; Cherepy, N.; Nov. 29, 1999; 18p; In English

Report No.(s): DE2002-792015; UCRL-JC-134326; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We report development of a pilot process for the industrial rinsing of fabrics. This process combines hydraulic (pressure-driven) transport with electro-osmotic transport. It reduces the total amount of water required in certain rinsing operations by a factor of about five. Cotton exhibits an electro-osmotic transport coefficient of about 6 times 10^{-9} to the minus 9th power m(sup 2)/s-V resulting from a partial ionization of hydroxyl groups on the cellulose polymer substrate. This process applies a field transverse to the fabric to effect the movement of water in the spaces between the 10 μ m cotton fibers which constitute the yam. The field strength is adjusted so that the induced electro-osmotic flux is comparable to a pressure-driven flux, which moves preferentially in the more open channels between the yams. For a fixed current density, solution conductivity and electro-osmotic transport vary inversely. The process is most practical for removal of liquids of relatively low conductivity (is less than 500 pS/cm). For removal of solutions of conductivity greater than 1200 micro S/cm, the rate of electro-osmotic flow may be too low to benefit the rinsing process if current densities are restricted to practical levels of about 30 mA/cm(sup 2). Electro-osmotic transport may have important applications in wet processing of extremely fine textiles, such as micro fiber fabrics. In addition to rinsing, electro-osmotic transport may also be used to speed the penetration of chemicals and dyestuffs that are applied to the surface of wet textiles.

NTIS

Current Density; Transport Properties; Textiles

20030006721 Combustion Engineering, Inc., Power Plant Labs., Windsor, CT USA

Advance Turbine System Conceptual Design and Product Development Annual Report

Mayer, A. H.; May 12, 1998; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-778069; No Copyright; Avail: National Technical Information Service (NTIS)

This is the third annual technical progress report for the subject program since the contract was signed on April 24, 1995. The discussions are organized by WBS task. There is also a general discussion at the end.

NTIS

Product Development; Design Analysis; Turbines

20030006723 Combustion Engineering, Inc., Windsor, CT USA

Advance Turbine System Conceptual Design and Product Development. Topical Report for Non-Destructive Techniques for the Evaluation of Overlay and Thermal Barrier Coatings on Gas Turbine Components

Cybulsky, M.; Mar. 10, 1998; 22p; In English

Report No.(s): DE2002-778009; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

During engine service protective coatings slowly degrade and this degradation process effectively controls the life of the part, particularly in situations where a thermal barrier coating (TBC) is used to protect against excessive metal temperatures. In this case growth of the oxide at the interface between the bond coat and the TBC leads to a build-up of stress in the TBC which can be relieved by a spalling of the ceramic layer and loss of the protection from the thermal barrier. In situations where the integrity of the TBC system is critical to the survival of the part, some non-destructive method of determining the degradation condition of the bond coat would clearly be advantageous. In this report the results are described of recent progress in a program to develop non-destructive methods to measure coating quality and to monitor the condition of coatings in service. The work which has formed part of the Advanced Turbine Systems (ATS) Project funded by DOE, has involved the use of eddy-current (ET) and ultrasonic (US) methods developed by SouthWest Research Institute (SwRI) who have been responsible for development of the technique.

NTIS

Gas Turbine Engines; Protective Coatings; Engine Parts; Ceramics; Thermal Control Coatings

Includes physical, chemical, and mechanical properties of laminates and other composite materials.

20030005448 NASA Langley Research Center, Hampton, VA USA

Finite Element Modeling of the Buckling Response of Sandwich Panels

Rose, Cheryl A., NASA Langley Research Center, USA; Moore, David F., Lockheed Martin Engineering and Sciences Co., USA; Knight, Norman F., Jr., Veridian Systems Div., USA; Rankin, Charles C., Lockheed Martin Advanced Technology Center, USA; [2002]; 19p; In English; 43rd AIAA/ASME/ASCE Structures, Structural Dynamics and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS1-00135; NAS1-99069; GS-35F-0038J

Report No.(s): AIAA Paper 2002-1517; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A comparative study of different modeling approaches for predicting sandwich panel buckling response is described. The study considers sandwich panels with anisotropic face sheets and a very thick core. Results from conventional analytical solutions for sandwich panel overall buckling and face-sheet-wrinkling type modes are compared with solutions obtained using different finite element modeling approaches. Finite element solutions are obtained using layered shell element models, with and without transverse shear flexibility, layered shell/solid element models, with shell elements for the face sheets and solid elements for the core, and sandwich models using a recently developed specialty sandwich element. Convergence characteristics of the shell/solid and sandwich element modeling approaches with respect to in-plane and through-the-thickness discretization, are demonstrated. Results of the study indicate that the specialty sandwich element provides an accurate and effective modeling approach for predicting both overall and localized sandwich panel buckling response. Furthermore, results indicate that anisotropy of the face sheets, along with the ratio of principle elastic moduli, affect the buckling response and these effects may not be represented accurately by analytical solutions. Modeling recommendations are also provided.

Author

Sandwich Structures; Buckling; Finite Element Method; Shear Stress; Modulus of Elasticity; Predictions

20030005458 NASA Langley Research Center, Hampton, VA USA

Intralaminar and Interlaminar Progressive Failure Analysis of Composite Panels with Circular Cutouts

Goyal, Vinay K., Virginia Polytechnic Inst. and State Univ., USA; Jaunky, Navin, Institute for Computer Applications in Science and Engineering, USA; Johnson, Eric R., Virginia Polytechnic Inst. and State Univ., USA; Ambur, Damodar, NASA Langley Research Center, USA; [2002]; 12p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NCC1-398

Report No.(s): AIAA Paper 2002-1745; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A progressive failure methodology is developed and demonstrated to simulate the initiation and material degradation of a laminated panel due to intralaminar and interlaminar failures. Initiation of intralaminar failure can be by a matrix-cracking mode, a fiber-matrix shear mode, and a fiber failure mode. Subsequent material degradation is modeled using damage parameters for each mode to selectively reduce lamina material properties. The interlaminar failure mechanism such as delamination is simulated by positioning interface elements between adjacent sublaminae. A nonlinear constitutive law is postulated for the interface element that accounts for a multi-axial stress criteria to detect the initiation of delamination, a mixed-mode fracture criteria for delamination progression, and a damage parameter to prevent restoration of a previous cohesive state. The methodology is validated using experimental data available in the literature on the response and failure of quasi-isotropic panels with centrally located circular cutouts loaded into the postbuckling regime. Very good agreement between the progressive failure analyses and the experimental results is achieved if the failure analyses includes the interaction of intralaminar and interlaminar failures.

Author

Composite Structures; Failure Analysis; Laminates; Delaminating; Axial Stress; Buckling

20030005591 NASA Glenn Research Center, Cleveland, OH USA

Characteristics of Pool Boiling on Graphite-Copper Composite Surfaces

Zhang, Nengli, Ohio Aerospace Inst., USA; Chao, David F., NASA Glenn Research Center, USA; Yang, Wen-Jei, Michigan Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November

2002; Volume 2444-445; 2p; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Nucleate pool boiling performance of different liquids on graphite-copper composite (Gr-Cu) surfaces has been experimentally studied and modeled. Both highly wetting fluids, such as freon-113 and pentane, and a moderately wetting fluid (water) were tested on the Gr-Cu surfaces with different graphite-fiber volume fractions to reveal the enhancement effects of the composite surfaces on the nucleate pool boiling. Results of the experiments show that the graphite-fiber volume fraction has an optimum value. The Gr-Cu composite surface with 25 percent graphite-fiber volume ($f=0.25$) has a maximum enhancement effect on the nucleate boiling heat transfer comparing to the pure copper surface. For the highly wetting fluid, the nucleate boiling heat transfer is generally enhanced on the Gr-Cu composite surfaces by 3 to 6 times shown. In the low heat flux region, the enhancement is over 6 times, but in the high heat flux region, the enhancement is reduced to about 40%. For the moderately wetting fluid (water), stronger enhancement of nucleate boiling heat transfer is achieved on the composite surface. It shown the experimental results in which one observes the nucleate boiling heat transfer enhancement of 5 to 10 times in the low heat flux region and an enhancement of 3 to 5 times in the high heat flux region. Photographs of bubble departure during the initial stage of nucleate boiling indicate that the bubbles detached from the composite surface are much smaller in diameter than those detached from the pure copper surface. Typical photographs are presented. It shows that the bubbles departed from the composite surface have diameters of only $O(0.1)$ mm, while those departed from the pure copper surface have diameters of $O(1)$ mm. It is also found that the bubbles depart from the composite surface at a much higher frequency, thus forming vapor columns. These two phenomena combined with high thermal conductivity of the graphite fiber are considered the mechanisms for such a significant augmentation in nucleate boiling heat transfer on the composite surfaces. A physical model is developed to describe the phenomenon of bubble departure from the composite surface: The preferred site of bubble nucleation is the fiber tip because of higher tip temperature than the surrounding copper base and poor wettability of the graphite tip compared with that of the base material (copper). The high evaporation rate near the contact line produces the vapor cutback due to the vapor recoil pushing the three-phase line outwards from the fiber tip, and so a neck of the bubble is formed near the bubble bottom. Evaporation and surface tension accelerate the necking process and finally result in the bubble departure while a new small bubble is formed at the tip when the surface tension pushes the three-phase line back to the tip. The process is schematically shown. The proposed model is based on and confirmed by experimental results.

Author

Bubbles; Graphite; Copper Compounds; Surface Diffusion; Heat Transfer; Nucleate Boiling

20030006097 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Effects of Microstructure on Damage Evolution, Strain Inhomogeneity, and Fracture in a Particulate Composite

Liu, C. T.; Jun. 1999; 18p; In English

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408402; AFRL-PR-ED-TP-99-0132; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Presentation slides for conference lecture on effects of microstructure on damage evolution, strain inhomogeneity, and fracture in a particulate composite.

DTIC

Damage; Microstructure; Particulates; Composite Materials; Inhomogeneity; Fracture Mechanics

20030006102 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Determination of Equivalent Initial Flaw Size in a Particulate Composite Material

Liu, C. T.; Yang, J. N.; Jul. 2000; 19p; In English; Prepared in collaboration with Univ. of California, Irvine, Irvine, CA. Pres. at Specialty Conf. on Probabilistic Mechanics and Structural Reliability (8th). Held in South Bend, IN, 24-26 Jul 2000

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408410; AFRL-PR-ED-TP-2000-148; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Presentation slides for conference lecture on the determination of equivalent initial flaw size in a particulate composite material.

DTIC

Composite Materials; Particulates; Crack Propagation; Size (Dimensions); Conferences

20030006103 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Analysis of Subinterface Cracks

Liu, C. T.; Wang, L.; Atluri, S. N.; Aug. 2000; 12p; In English; Prepared in collaboration with Univ. of California, Los Angeles, CA. Pres. at Int. Conf. on Computational Science. Held in Anaheim, CA, 21-25 Aug 2000

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408413; AFRL-PR-ED-TP-2000-159; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Presentation slides for conference lecture on findings of analysis on subinterface cracks.

DTIC

Conferences; Crack Propagation; Mechanical Properties; Interfaces

20030006106 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Microstructure Induced Inhomogeneous Strain in a Particulate Composite

Liu, C. T.; Gonzales, J.; Jun. 1999; 16p; In English; Presented at 1999 ASME Summer Conference

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408417; AFRL-PR-ED-TP-99-0133; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Presentation slides for conference lecture on microstructure induced inhomogeneous strain in a particulate composite.

DTIC

Conferences; Microstructure; Particulates; Composite Materials; Inhomogeneity

20030006110 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Strain Rate Effect on Crack Opening and Growth in a Particulate Composite Material at Low Temperature

Liu, C. T.; Jun. 2000; 5p; In English; Presented at International Conf. on Mechanics of Time Dependent Materials (3rd). Held in Erlangen, Germany, 17-20 Sep 2000. Missing pages

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408424; AFRL-PR-ED-AB-2000-131; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Over the past years, a considerable amount of work has been done in studying crack growth behavior in highly filled polymeric materials (1-4). These materials consist of hard particles embedded in soft polymeric binder, such as rubber, and behave like viscoelastic materials. Therefore, the mechanical and fracture behaviors of such materials can be strongly influenced by the loading rate, temperature, and material microstructure. Thus, in order to obtain a fundamental understanding of the crack growth behavior in the particulate composite materials, the effects of loading rate and temperature on the crack growth behavior need to be determined.

DTIC

Composite Materials; Crack Propagation; Low Temperature; Particulates; Strain Rate

20030006112 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Determination of Equivalent Initial Flaw Size in a Particulate Composite Material

Liu, C. T.; Yang, J. N.; Apr. 2000; 8p; In English; Prepared in collaboration with Univ. of California, Los Angeles, CA. Pres. at ASCE Conf. on Probabilistic Mechanics and Structural Reliability (8th). Held in South Bend, IN, 24-26 Jul 2000

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408431; AFRL-PR-ED-TP-2000-080; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In this study, a method for determining the initial flaw size in a particulate composite material is developed. The results of analyses indicate that the initial flaw length and the critical flaw size follow the second asymptotic distribution of maximum value. It also indicates that on the first approximation, it can be assumed that the initial flaw size and the critical flaw size is independent of specimen thickness.

DTIC

Composite Materials; Defects; Particulates; Crack Propagation; Approximation

20030006446 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Test Geometries for Bondline Cracked Photoelastic Models: Preliminary Results

Smith, C. W.; Gloss, K. T.; Liu, C. T.; Oct. 1999; 9p; In English; Prepared in collaboration with Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Pres. at ASME 1999 Mechanical Engineering Congress and Exposition

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408419; AFRL-PR-ED-TP-1999-0196; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Preliminary results and figures of test geometries for bondline cracked photoelastic models.

DTIC

Bonded Joints; Composite Materials; Photoelastic Materials; Mathematical Models; Crack Geometry

20030006679 Old Dominion Univ., Center for Advanced Engineering Environments, Hampton, VA USA

Nonlinear Thermomechanical Response of Composite Panels with Continuous and Terminated Stiffeners

Noor, Ahmed K., Old Dominion Univ., USA; Peters, Jeanne M., Old Dominion Univ., USA; [2001]; 17p; In English; 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference and Exhibit, 16-19 Apr. 2001, Seattle, WA, USA

Contract(s)/Grant(s): NAG1-01028

Report No.(s): AIAA Paper 2001-1237; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

A two-phase approach and a computational procedure are used for predicting the variability of the response of stiffened composite panels associated with variations in the geometric and material parameters of the structures. In the first phase, hierarchical sensitivity analysis is used to identify the major parameters that have the most effect on the response quantities of interest. In the second phase, the major parameters are taken to be fuzzy parameters, and a fuzzy set analysis is used to determine the range of variation of the response, associated with preselected variations in the major parameters. Numerical results are presented showing the variability of the response of panels with both continuous and terminated stiffeners associated with variations in the micro mechanical and geometric parameters. Both flat and curved panels are considered.

Author

Nonlinearity; Thermodynamics; Composite Structures; Computation

20030006690 Clarkson Univ., Div. of Research, Potsdam, NY USA

Quantification of Energy Release in Composite Structures Final Report, 1 Jul. 2000 - 30 Sep. 2002

Minnetyan, Levon, Clarkson Univ., USA; January 2003; 106p; In English

Contract(s)/Grant(s): NAG3-2393; Proj. 375-32636; Proj. 375-570; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Energy release rate is usually suggested as a quantifier for assessing structural damage tolerance. Computational prediction of energy release rate is based on composite mechanics with micro-stress level damage assessment, finite element structural analysis and damage progression tracking modules. This report examines several issues associated with energy release rates in composite structures as follows: Chapter I demonstrates computational simulation of an adhesively bonded composite joint and validates the computed energy release rates by comparison with acoustic emission signals in the overall sense. Chapter II investigates the effect of crack plane orientation with respect to fiber direction on the energy release rates. Chapter III quantifies the effects of contiguous constraint plies on the residual stiffness of a 90 deg ply subjected to transverse tensile fractures. Chapter IV compares ICAN and ICAN/JAVA solutions of composites. Chapter V examines the effects of composite structural geometry and boundary conditions on damage progression characteristics.

Author

Composite Structures; Kinetic Energy; Adhesive Bonding; Bonded Joints; Cracks; Fiber Orientation; Tensile Stress

25

INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see also 34 Fluid Dynamics and Thermodynamics, For astrochemistry see category 90 Astrophysics.

20030005512 Birmingham Univ., UK

The Kinetics and Dynamics of Elementary Gas-Phase Reactions

Tuckett, Richard P.; Sep. 2002; 78p; In English; Original contains color images

Contract(s)/Grant(s): F61775-02-WF080

Report No.(s): AD-A408462; No Copyright; Avail: Defense Technical Information Center (DTIC)

This is an interdisciplinary conference, given in honor of Prof. I.W.M. Smith. Topics include: Reaction Dynamics and Energy Transfer; Gas Kinetics and Atmospheric Chemistry; Astrochemistry Theoretical Chemical Dynamics and Kinetics.

DTIC

Kinetics; Gas Dynamics

20030005531 Massachusetts Inst. of Tech., Dept. of Chemical Engineering, Cambridge, MA USA

Compression of Paramagnetic Colloidal Chains

Smith, Daniel J., Massachusetts Inst. of Tech., USA; Gast, Alice P., Massachusetts Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 8; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The electric or magnetic field-induced aggregation of polarizable particles produces a rapid rheological transition known as electrorheological (ER) or magnetorheological (MR) response. The ability to tune these interactions with an external field makes them attractive for feedback-controlled devices such as shock absorbers and suspension systems. In response to an applied magnetic field, paramagnetic colloidal suspensions aggregate into anisotropic microstructures that produce the bulk rheological response. The microstructure is composed of chains, columns of chains and chain networks. The deformation and rupturing of this microstructure leads to a finite yield stress for the suspension. In this work, we investigate the strengths and interactions of chains and columns of chains to compression parallel to the applied magnetic field with optical tweezers. Optical trapping is used to manipulate the microstructure and to measure the forces resisting its distortion. The iron oxide present in the particles prevents us from trapping them directly, so we use a tether-handle system utilizing latex particles attached to the magnetic particles via the biotin-streptavidin binding reaction. Using optical traps, we explore the response of single chains and columns of chains to compression. We find that chains bend and undergo reorganization processes before their ultimate failure due to rupture. We believe that these reorganization events are key mechanisms of stress reduction. Columns of chains exhibit the same mechanisms, but higher forces are required for both the rearrangements and column failure. This strengthening is caused by the enhanced local field due to additional magnetized particles and the additional strength of the column due to the multiple chain interactions. We show how these studies provide mechanistic explanations of magnetic suspension rheology. We model the microstructures and forces through numerical simulations.

Author

Colloids; Magnetic Fields; Rheology; Paramagnetism; Mathematical Models; Microstructure

20030005534 Atlanta Univ., Dept. of Physics, GA USA

Local Perturbations of Jammed Colloids

Weeks, Eric R., Atlanta Univ., USA; Habdas, Piotr, Atlanta Univ., USA; Schaar, David, Atlanta Univ., USA; Levitt, Andrew C., Atlanta Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 12; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We use confocal microscopy to directly study the microscopic behavior of colloidal glasses and colloidal supercooled liquids. In particular we embed superparamagnetic particles into the system of non-magnetic PMMA colloids and then exert an external magnetic force on these particles to locally perturb the sample in a controlled manner. We investigate the range of these perturbations as a function of magnetic particle size, magnetic force, and colloidal particle concentration, in samples approaching the colloidal glass transition. The results of such studies address broader issues of both a universal description of the origin of the glass transition and also the flow of granular media studied by other groups.

Author

Colloids; Microscopy; Paramagnetism; Perturbation; Liquids

20030005535 National Center for Microgravity Research on Fluids and Combustion, Cleveland, OH USA

Instability of Miscible Interfaces

Balasubramaniam, R., National Center for Microgravity Research on Fluids and Combustion, USA; Rashidnia, N., National Center for Microgravity Research on Fluids and Combustion, USA; Boggess, M. J., National Center for Microgravity Research on Fluids and Combustion, USA; Schroer, R. T., National Center for Microgravity Research on Fluids and Combustion, USA; Maxworthy, T., University of Southern California, USA; Wilson, R. G., Case Western Reserve Univ., USA; Alexander, J. I. D., Case Western Reserve Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 14-25; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The dynamics of miscible displacements in a cylindrical tube is being studied experimentally and numerically, specifically when a more viscous fluid displaces a less viscous fluid. In the converse situation where a less viscous fluid displaces a more viscous fluid, a fingering instability is known to occur (Petitjeans and Maxworthy, 1996), and a flight experiment proposed by Maxworthy and Meiburg to investigate the interface dynamics in this case is currently being developed by NASA. From the current theory of miscible displacements, developed for a porous medium satisfying Darcy's law (see review by Homsy, 1987), it can be shown that in the absence of gravity the interface between the fluids is destabilized and thus susceptible to fingering only

when a more viscous fluid is displaced by a less viscous one. Therefore, the initial flat interface in the displacement of a less viscous fluid by a more viscous one ought to be stable. However, numerical simulations by Chen and Meiburg (1996) for such displacement in a cylindrical tube show that for a viscosity ratio equal to e , a finger of the more viscous fluid is indeed formed. These calculations were restricted to axisymmetric solutions of the Stokes equations that are valid for negligible values of the Reynolds number. We report on the experiments that we have conducted to date when a more viscous fluid displaces a less viscous one in a vertical cylindrical tube. The experiments show that not only can a finger form in this instance but also that under certain conditions the advancing finger achieves a sinuous or snake-like spatial pattern. These experiments were performed using silicone oils in a vertical pipette of small diameter. The more viscous fluid also has a slightly larger density than the less viscous fluid. In the initial configuration, the fluids were under rest, and the interface was nominally flat. Both stably and unstably stratified initial configurations were studied.

Author

Stability; Solubility; Viscous Fluids; Liquid-Liquid Interfaces

20030005669 Florida Univ., Dept. of Chemical Engineering, Gainesville, FL USA

In-Situ Oxygen-Atom Erosion Study of a Polyhedral Oligomeric Silsesquioxane Polyurethane Copolymer

Hoflund, Gar B.; Gonzalez, Rene I.; Phillips, Shawn H.; Dec. 06, 2000; 29p; In English; Presented at the Intl. Symposium on Interfaces in Polymer Composites, held on 18 Dec. 2000

Report No.(s): AD-A408098; AFRL-PR-ED-TP-2000-232; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The surface of a polyhedral oligomeric silsesquioxane polyurethane copolymer has been characterized in-situ using X-ray photoelectron spectroscopy before and after exposure to incremental fluences of oxygen atoms produced by a hyperthermal oxygen atom source. The data indicate that the atomic oxygen initially attacks the cyclopentyl groups that surround the polyhedral oligomeric silsesquioxane cage, resulting in the formation and desorption of CO₂ from the surface. The carbon concentration in the near surface region is reduced from 72.5 at% for the as-entered surface to 37.8 at% following 63 hrs of 0-atom exposure at a flux of 10(exp 14) 0-atoms/sq cm-s. The oxygen and silicon concentrations are increased with incremental exposures to the 0-atom flux. The oxygen concentration increases from 18.5 at% for the as-entered sample to 32.6 at% following the 63 hr exposure, and the silicon concentration increases from 8.1 to 11.1 at% after 63 hrs. The data reveal the formation of a silica layer on the surface which serves as a protective barrier preventing further degradation of the polymer underneath with increased exposure to the 0-atom flux.

DTIC

Silicon Dioxide; Copolymerization; Photoelectron Spectroscopy; X Ray Spectroscopy; Copolymers

20030005671 University of Southern California, Loker Hydrocarbon Research Inst., Los Angeles, CA USA

A New Synthesis of Anhydrous Cesium Salts

Haiges, Ralf; Christe, Karl O.; Oct. 2001; 9p; In English

Contract(s)/Grant(s): F04611-99-C-0025

Report No.(s): AD-A408096; AFRL-PR-ED-TP-2001-203; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Contrary to ammonium salts many cesium salts are extremely hygroscopic. Consequently, anhydrous ammonium salts are readily available in anhydrous form by neutralizing the corresponding acids with ammonia, but their conversion to anhydrous cesium salts is difficult.

DTIC

Anhydrides; Hygroscopicity; Ammonia

20030005819 Alabama Univ., Huntsville, AL USA

Reduction of Convection in Closed Tube Vapor Transport Experiments Final Report, 1 May 1998 - 31 Jan. 2002

Naumann, R. J., Alabama Univ., USA; Tan, Sarwa Bakti, Alabama Univ., USA; Shin, In-Seok, Alabama Univ., USA; Kim, Joo Soo, Alabama Univ., USA; Aug. 12, 2002; 27p; In English

Contract(s)/Grant(s): NAG8-1464; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary objective of this effort was to develop a method for suppressing convective flows during the growth of mercurous chloride crystals by vapor transport in closed tubes to levels approaching those obtained in the microgravity environment. Mercurous chloride was chosen because it is a technologically interesting acoustical optical material whose optical properties are believed to be affected by convective flows. Since the Grashof number scales as the cube of the smallest dimension in the flow system, reduction of the size scale can be extremely effective in reducing unwanted convective flows. However, since materials of practical interest must be grown at least on the cm scale, reduction of the overall growth system is not feasible. But if the region just above the growing crystal could be restricted to a few mm, considerable reduction in flow velocity would result. by suspending

an effusive barrier in the growth ampoule just above the growth interface, it should be possible to reduce the convective velocity in this vicinity to levels approaching flows in microgravity. If successful, this growth technique will offer a screening test for proposed space experiments that involve vapor transport to see if reduction of convection will result in improved material and will set a new standard against which the improvements obtained in microgravity may be judged. In addition, it may provide an improved method for preparing materials on Earth whose growth is affected adversely by convection. If the properties of this material can be improved there is a potential commercial interest from Brimrose Inc., who has agreed to fabricate and test devices from the crystals we have grown. This report describes the development of the growth facility, the purification processes developed for preparing the starting material, and the results from growth experiments with and without the effusive baffle. Mercurous chloride turned out to be a more difficult material to deal with than originally anticipated. At growth temperatures, it is extremely sensitive to practically any impurity which causes it to form oxychlorides and/or to decompose into elemental mercury and bichloride of mercury. We were unable to find a suitable method for protecting the magnetic material used to suspend the effusion barrier from the attack of mercurous chloride vapor. Although we were successful in growing single crystals of mercurous chloride without the effusion baffle, they exhibited severe microcracking which we attribute to wall-induced thermal stresses. This leads us to believe that uncontrolled convection may not be the most important problem in the development of this material and a new growth process was attempted that eliminates the wall-induced stress. Unfortunately, the grant ran out before this new method could be adequately tested.

Author

Convective Flow; Vapor Deposition; Chlorides; Crystal Growth; Optical Materials

20030005937 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

On the Lewis Acidity of LiF

Vij, V.; Boatz, J. A.; Tham, F.; Vij, A.; Christe, K. O.; Apr. 2000; 3p; In English; Symposium of Fluorine Chemistry (16th). Held in Durham, UK, 23 Jul 2000

Contract(s)/Grant(s): AF Proj. 2303

Report No.(s): AD-A408369; AFRL-PR-ED-AB-2000-075; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Based on the recently developed pF Lewis acidity scale, free gaseous LiF is a surprisingly strong Lewis acid, comparable to SiF₄. It was therefore of interest to study whether a strong Lewis base, such as CsF, could transfer a fluoride ion to LiF with formation of a LiF₂ anion. Theoretical calculations were carried out for LiF₂ and show that free gaseous LiF₂ is a linear, vibrationally stable species. Furthermore, the phase-diagram of the LiF/CsF system shows a eutectic at a 1:1 mole ratio that gives a distinct X-ray powder diffraction pattern. We have prepared this eutectic by fusion of a 1:1 mixture of LiF and CsF in a platinum crucible. Single crystals were obtained by slow cooling of the melt in a dry nitrogen stream. The resulting product was characterized by vibrational spectroscopy, and its crystal structure was determined. It is shown that CsLiF₂ does not contain isolated LiF₂ anions, but exhibits an interesting three-dimensional network of alternating tetra-coordinated LiF₄ and octa-coordinated CsF₈ units.

DTIC

Lithium Fluorides; Acidity

20030005947 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Chemistry of N-F Containing HEDM Materials and on Lewis Acidity of LiF

Vij, Vandana; Vij, Ashwani; Wilson, William W.; Christe, Karl O.; Sheehy, Jeffery A.; Oct. 03, 2000; 4p; In English; Prepared in cooperation with University of California, Riverside, CA and University of Southern California, Los Angeles, CA. Presented at the HEDM Contractors Conference held in Park City, Utah on 24 Oct. 2000

Contract(s)/Grant(s): AF Proj. 2303

Report No.(s): AD-A408393; AFRL-PR-ED-TP-2000-189; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The recent isolation of the N₅⁺ cation is one of the most amazing discoveries of modern chemistry. This statement is justified by the fact that this is the first all nitrogen homoleptic species to be isolated in more than a century, and only the third known species of this kind besides atmospheric nitrogen (N₂) and the azide ion (N₃⁻). The N₅⁽⁺⁾AsF₆⁽⁻⁾ salt is only marginally stable at room temperature. In order to prepare other more stable N₅⁽⁺⁾ salts for application as high energy density material, it was necessary to prepare the corresponding precursors in an efficient manner and in large quantities. The choice of common natural graphite flake as opposed to HOPG for the graphite. AsF₅ intercalate formation reduces not only the cost drastically, but also the intercalation time from several weeks to two days. This intercalate is then used to reduce N₂F₄ to N₂F₂. Using the graphite flake intercalate, this reduction reaction was accomplished in several hours instead of weeks with minimal formation of by-products. Another major discovery made during this study is the catalytic conversion of trans-N₂F₂ to its cis-isomer when SbF₅ is used as the Lewis acid. This reduces the number of steps required for the preparation of the precursor, N₂F⁽⁺⁾SbF₆⁽⁻⁾, and avoids the

need for an extra step involving the corresponding expensive $\text{AsF}_6(-)$ salt. Also, discovered during the isomerization studies is a novel synthetic route to prepare $\text{NF}_4(+)$ salts at relatively low temperature and pressure that does not require elemental fluorine and NF_3 . A structural analysis of the $\text{N}_2\text{F}(+)$ cation was also carried out by the crystal structure determination of $\text{N}_2\text{F}(+)\text{SbF}_6(-)$ and $\text{N}_2\text{F}(+)\text{Sb}_2\text{F}_{11}(-)$.

DTIC

Oxidation-Reduction Reactions; Nitrogen Compounds; Lithium Fluorides

20030006253 Sierra Engineering, Inc., Carson City, NV USA

Swirl Coaxial Injector Development, Part II: CFD Modeling

Cheng, Gary; Johnson, Curtis; Muss, Jeff; Jan. 10, 2002; 4p; In English

Contract(s)/Grant(s): F04611-01-C-0010; AF Proj. BMDO

Report No.(s): AD-A408257; AFRL-PR-ED-TP-2002-007; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Injector design is crucial to obtain long life and provide high energy release efficiency in the main combustion chamber. Introducing a swirl component in the injector flow can enhance the propellant mixing and thus improve engine performance. Therefore, swirl coaxial injectors show promise for the next generation of high performance staged combustion rocket engines utilizing hydrocarbon fuels. These injectors swirl liquid fuel around a gaseous oxygen core. This work develops a design methodology, utilizing both high-pressure cold-flow testing and uni-element hot-fire testing to create a high performing, long life swirl coaxial injector for multi-element combustor use. Several swirl coax injector configurations were designed and fabricated by Sierra Engineering, and tested at the Propulsion Directorate of the Air Force Research Lab. Both cold-flow and hot-fire tests were conducted. CFD analyses have been performed to assess the ability of CFD to provide detailed insight into the flowfield and improve our understanding of the underlying flow characteristics of an optimized injector design. Both cold-flow and hot-fire analyses were completed. The CFD code utilized was the FDNS-RFV code with the homogeneous real-fluid model employed to simulate the spray combustion phenomena for both the cold flow and hot fire conditions. Initial results show that large scale phenomenology was predicted well by the cold-flow CFD analysis (see Figure 1). Detail flow-field characteristics will be compared when the CFD analyses are completed that match actual test operating conditions. The FDNS-RFV code has been widely employed by NASA MSFC to analyze various flow problems of rocket engines. Analysis and test comparisons will be presented and an assessment of the utility of the analyses will be discussed.

DTIC

Injectors; Propellants; Combustion Physics; Flow Characteristics; Flow Distribution

20030006254 Sierra Engineering, Inc., Carson City, NV USA

Swirl Coaxial Injector Development, Part I: Test Results

Muss, Jeff; Johnson, Curtis; Cohn, Richard; Strakey, Peter; Bates, Ron; Jan. 10, 2002; 4p; In English

Contract(s)/Grant(s): F04611-01-C-0010; AF Proj. BMDO

Report No.(s): AD-A408256; AFRL-PR-ED-TP-2002-006; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Injector design is crucial to obtain long life and provide high energy release efficiency in the main combustion chamber. Introducing a swirl component in the injector flow can enhance the propellant mixing and thus improve engine performance. Therefore, swirl coaxial injectors show promise for the next generation of high performance staged combustion rocket engines utilizing hydrocarbon fuels. These injectors swirl liquid fuel around a gaseous oxygen core. This work develops a design methodology, utilizing both high-pressure cold-flow testing and uni-element hot-fire testing to create a high performing, long life swirl coaxial injector for multi-element combustor use. Several swirl coax injector configurations were designed and fabricated by Sierra Engineering, and tested at the Propulsion Directorate of the Air Force Research Lab. Both cold-flow and hot-fire tests were conducted. Cold-flow testing used near-field shadowgraphs and patternation to investigate atomization, non-combusting mixing efficiency, and flow uniformity. The cold-flow results (Figures 1 and 2) allowed ranking injector performance in terms of pressure drop, drop size, spray uniformity, and mixing. The most promising injectors were then installed in a combustor and hot-fire tested. The hot-fire tests demonstrated uni-element performance, ignition characteristics, and some stability characteristics. In addition, the injector elements have been operated at several different mixture ratios to characterize off-design performance. Work in progress (to be completed before the conference) includes flame imaging to better understand flame holding characteristics, and near field combustion phenomena of these swirler elements. The results of the cold-flow and hot-fire tests were compared to discern what phenomena observed during cold flow testing is directly applicable to hot-fire operation.

DTIC

Combustion Physics; Propellants; Injectors

20030006288 Rennes Univ., France

Synchrotron Radiation Based Study of X-Ray Absorption of Flame Generated Nanoparticles *Final Report, 5 Sep. 2001-5 Sep 2002*

Mitchell, J. B.; Sep. 16, 2002; 33p; In English; Original contains color images

Contract(s)/Grant(s): F61775-01-WE060

Report No.(s): AD-A408480; EOARD-SPC-01-4060; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report results from a contract tasking University of Rennes I as follows: The contractor will perform a study of soot growth and nucleation by a time-resolved synchrotron radiation based x-ray absorption method'. A gaseous fuel burner will be constructed that will allow a stable flame to be produced. It is here proposed to perform synchrotron-based experiments in which the mobility of the charged species can be studied. Such measurement is possible since the synchrotron radiation has a well-defined time structure and pump-probe type experiments can be performed. In order to do this correctly however, it is desirable to perform the experiments under vacuum and so a pre-mixed type of flame will be used. The burner assembly will be mounted in a vacuum chamber that can be mounted on the synchrotron radiation experimental bench. It is proposed to use cryopumping in order to achieve the high pumping rates necessary to allow a flame to burn in vacuum. (Cryopumping rates are typically 10l/sec per square centimeter of cryosurface). In addition to the mobility experiments, it is proposed to examine the effects of incident wavelength on the absorption process in order to compare the results so obtained with existing models of x-ray absorption by graphite dust particles. The goal of this work is to study the influence of the incident x-ray wavelength on the absorption process. The experimentation will be performed at the University of Rennes using the UV lasers in their laboratory. These will be used to investigate the thermal ionization of soot particles. The experiment will also be tried at the Vacuum Ultra Violet undulator beamline SU5 at the LURE synchrotron in Paris. If scheduling permits, this experiment will be performed using UV light in the 5-40 eV range.

DTIC

Soot; Synchrotron Radiation; X Ray Absorption

20030006293 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Method for Solving Some Disordered Crystal Structures and its Application to the Structures of NF₂O⁺ and SO₂F⁻

Christe, Karl O.; Vij, Ashwani; Mews, Rudiger; Zhang, Xiongzh; Boatz, Jerry; Sep. 2000; 3p; In English; Prepared in collaboration with Univ. of Southern California, Los Angeles, CA, and Univ. of Bremen, Bremen, Germany

Contract(s)/Grant(s): Proj. 2303

Report No.(s): AD-A408458; AFRL-PR-ED-AB-2000-181; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Oxygen and fluorine ligands are similar in size and frequently exhibit positional disorder in the crystal structures of oxofluorides, resulting in a partial or complete averaging of the observed bond lengths and angles. The failure to recognize the presence of disorder has resulted in the publication of numerous incorrect structures, while the recognition of disorder problems has generally prompted researchers to abandon these data sets. In this paper, a method is outlined which allows in favorable cases the extraction of the correct individual bond lengths and angles from disordered data. The method is demonstrated for the SO₂F⁻ and NOF₂⁺ ions, and the correctness of the derived bond lengths is supported by ab initio calculations for the free ions.

DTIC

Crystal Structure; Nitrogen Oxides

20030006294 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Recent Progress in Nitrogen Fluoride Chemistry

Vij, Vandana; Vij, Ashwani; Wilson, William W.; Christe, Karl O.; Sep. 2000; 3p; In English; at Winter Fluorine Conf. (15th). Held in St. Petersburg, FL, 14 Jan 2001. Prepared in collaboration with Univ. of Southern California, Los Angeles, CA

Contract(s)/Grant(s): AD Proj. 2303

Report No.(s): AD-A408455; AFRL-PR-ED-AB-2000-182; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

For the preparation of N₅⁺ salts on a larger scale, it was necessary to prepare the corresponding precursors in an efficient manner and in large quantities. In this paper, process improvements in this direction are described. Furthermore, the catalytic conversion of trans-N₂F₂ to its cis-isomer is discussed. Also discovered during the isomerization studies was a novel synthetic route to NF₄⁺ salts at relatively low temperature and pressure. A structural analysis of the N₂F⁺ cation was also carried out for N₂F⁺SbF₆⁻ and N₂F⁺Sb₂F₁₁⁻.

DTIC

Isomerization; Nitrogen Compounds

20030006736 Akron Univ., Dept. of Chemical Engineering, Akron, OH USA

CO(2) Sequestration and Recycle by Photocatalysis with Visible Light Final Report, 1 Jul. 1999 - 30 Jun. 00

Chuang, S. S. C.; Oct. 2001; 28p; In English

Report No.(s): DE2002-802825; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Visible light-photocatalysis could provide a cost-effective route to recycle CO₂ to useful chemicals or fuels. Development of an effective catalyst for the photocatalytic synthesis requires (1) the knowledge of the surface band gap and its relation to the surface structure, (2) the reactivity of adsorbates and their reaction pathways, and (3) the ability to manipulate the activities site for adsorption, surface reaction, and electron transfer. The objective of this research is to study the photo-catalytic activity of TiO₂-base catalyst. A series of TiO₂-supported metal catalysts were prepared for determining the activity and selectivity for the synthesis of methane and methanol. 0.5 wt% Cu/SrTiO₃ was found to be the most active and selective catalyst for methanol synthesis. The activity of the catalyst decreased in the order: Ti silsesquioxane is greater than Cu/SrTiO₃ is greater than Pt/TiO₂ is greater than Cu/TiO₂ is greater than TiO₂ is greater than Rh/TiO₂. to further increase the number of site for the reaction, we propose to prepare monolayer and multiplayer TiO_x on high surface area mesoporous oxides. These catalysts will be used for in situ IR study in the Phase II research project to determine the reactivity of adsorbates. Identification of active adsorbates and sites will allow incorporation of acid/basic sites to alter the nature of CO₂ and H₂O adsorbates and with Pt/Cu sites to direct reaction pathways of surface intermediates, enhancing the overall activity and selectivity for methanol and hydrocarbon synthesis.

NTIS

Light (Visible Radiation); Catalytic Activity; Carbon Dioxide; Recycling

26

METALS AND METALLIC MATERIALS

Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.

20030005292 NASA Glenn Research Center, Cleveland, OH USA

A Deterministic Interfacial Cyclic Oxidation Spalling Model, Part 2, Algebraic Approximation, Descriptive Parameters, and Normalized Universal Curve

Smialek, James L., NASA Glenn Research Center, USA; December 2002; 24p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 708-73-05

Report No.(s): NASA/TM-2002-211906/PT2; NAS 1.15:211906/PT2; E-13596/PT2; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A cyclic oxidation interfacial spalling model has been developed in Part 1. The governing equations have been simplified here by substituting a new algebraic expression for the series (Good-Smialek approximation). This produced a direct relationship between cyclic oxidation weight change and model input parameters. It also allowed for the mathematical derivation of various descriptive parameters as a function of the inputs. It is shown that the maximum in weight change varies directly with the parabolic rate constant and cycle duration and inversely with the spall fraction, all to the 1/2 power. The number of cycles to reach maximum and zero weight change vary inversely with the spall fraction, and the ratio of these cycles is exactly 1:3 for most oxides. By suitably normalizing the weight change and cycle number, it is shown that all cyclic oxidation weight change model curves can be represented by one universal expression for a given oxide scale.

Author

Algebra; Oxidation; Spalling; Approximation; Mathematical Models; Normalizing (Heat Treatment)

20030005704 NASA Glenn Research Center, Cleveland, OH USA

A Deterministic Interfacial Cyclic Oxidation Spalling Model, Part 1, Model Development and Parametric Response

Smialek, James L., NASA Glenn Research Center, USA; December 2002; 27p; In English; Original contains color illustrations
Contract(s)/Grant(s): RTOP 708-73-05

Report No.(s): NASA/TM-2002-211906/PT1; NAS 1.15:211906/PT1; E-13596-1/PT1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An equation has been developed to model the iterative scale growth and spalling process that occurs during cyclic oxidation of high temperature materials. Parabolic scale growth and spalling of a constant surface area fraction have been assumed. Interfacial spallation of the only the thickest segments was also postulated. This simplicity allowed for representation by a simple deterministic summation series. Inputs are the parabolic growth rate constant, the spall area fraction, oxide stoichiometry, and cycle duration. Outputs include the net weight change behavior, as well as the total amount of oxygen and metal consumed, the

total amount of oxide spalled, and the mass fraction of oxide spalled. The outputs all follow typical well-behaved trends with the inputs and are in good agreement with previous interfacial models.

Author

Oxidation; Refractory Materials; Mathematical Models; Independent Variables; Spallation; Interfacial Tension

20030005713 Virginia Univ., Office of Sponsored Programs, Charlottesville, VA USA

Mechanisms of Crack Tip Hydrogen Embrittlement in High Strength Alloy Steels for Marine Applications *Final Report, 1 Jul. 1998-30 Jun. 2002*

Gangloff, R. P.; Scully, J. R.; Richey, E., III; Thomas, R. L.; Li, D.; Oct. 2002; 220p; In English

Contract(s)/Grant(s): N00014-98-1-0740

Report No.(s): AD-A408121; UVA 110723-101-GG10077-31340; FAS-5-25522; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

The primary objective of this research was to characterize and understand (a) the interaction of a range of bulk-dissolved hydrogen concentrations with the complex tempered martensitic microstructure of AerMet 100 ultra-high strength steel, (b) the effect of such trapped hydrogen on fracture resistance associated with internal hydrogen embrittlement (IHE), and (c) the levels of trapped and diffusible hydrogen achieved after cadmium plating and baking operations. Studies of hydrogen transport rates, trapping and redistribution after heating sought to correlate embrittlement-threshold levels with redistribution of diffusible hydrogen during IHE. A strong dependence of the threshold stress intensity (K_{th}) for the onset of IHE in AerMet 100 on diffusible H concentration was measured and modeled in this project. H was trapped at the interfaces of M(2)C precipitates that are responsible for strengthening of peak aged AerMet 100. Modeling showed that very high levels of H can redistribute within the crack tip process zone and promote transgranular fracture due to two factors; unexpectedly high crack tip normal and hydrostatic stresses, as well as substantial weak reversible H trapping at M(2)C precipitates unique to AerMet 100. Upon stressing, H redistributes to the crack tip process zone due to lattice dilation from the crack tip stress field.

DTIC

High Strength Alloys; Hydrogen Embrittlement; Crack Tips; Stress Intensity Factors; Stress Distribution

20030005736 Arizona State Univ., Dept. of Mechanical and Aerospace Engineering, Tempe, AZ USA

Prevention of Corrosion in Structural Aluminum Alloys *Final Report, Sep. 1996-31 Oct. 2002*

Sieradzki, K.; Carpenter, R. W.; Newman, R. C.; Dimitrov, N.; Leclerc, T. J.; Oct. 31, 2002; 59p; In English; Original contains color images

Contract(s)/Grant(s): F49620-96-1-0475; AF Proj. 3484

Report No.(s): AD-A408530; AFRL-SR-AR-TR-02-0386; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We examined the general phenomenology associated with the corrosion of Al Alloy 2024-T3. Copper redistribution is controlled by S-phase de-alloying and matrix de-alloying. Matrix de-alloying of aluminum occurs owing to the increased pH that develops at the alloy/electrolyte interface owing to oxygen reduction. We summarize results of a detailed investigation aimed at determining the mechanism and magnitude of the oxygen diffusion limited current density during corrosion of Al Alloy 2024-T3. Our results show that oxygen reduction occurs via the standard 4-electron mechanism and that the oxygen diffusion - limited current density has a value of approx. 25 $\mu\text{A cm}^{-2}$.

DTIC

Corrosion; Alloying; Current Density; Electrolytes; Gas Density; Prevention

20030005781 Alabama Univ., Center for Materials Research, Huntsville, AL USA

Novel Directional Solidification Processing of Hypermonotectic Alloys *Final Report*

Kaukler, William, Alabama Univ., USA; Fedoseyev, Alex, Alabama Univ., USA; Aug. 17, 2002; 17p; In English

Contract(s)/Grant(s): NCC8-209; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A model has been developed that determines the size of Liquid (sub 11) droplets generated during application of ultrasonic energy (as a function of amplitude) to immiscible alloys. The initial results are in accordance with experimental results based on Succinonitrile - Glycerol "alloys" and pure tin dispersions. Future work will take into account the importance of other effects, e.g., thermo-vibrational convection, sound attenuation, viscosity variations, and compositional changes.

Derived from text

Directional Solidification (Crystals); Drops (Liquids); Monotectic Alloys; Liquid Phases; Ultrasonics; Mathematical Models

20030005923 Argonne National Lab., IL USA

Modeling the Long-Term Degradation of a Metallic Waste Form

Bauer, T. H.; Johnson, S. G.; Snyder, C. T.; Sep. 2002; 14p; In English

Report No.(s): DE2002-801638; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The principal aim of this effort is to develop models of long-term metal waste form (MWF) degradation that are credible, mechanistically based, and empirically calibrated. Utilizing new experimental data and analyses, this paper outlines an updated approach and summarizes the progress made. The current modeling approach emphasizes the analysis of constituent release data from immersion tests. A significant amount of recently obtained immersion test data is described. Test solutions included both mild (well-water), and aggressive (high-chloride and strongly acidic) environments. In addition to predominant constituents Fe, Zr, Cr., and Ni, MWF test samples included: U, Pu, Tc, and Np.

NTIS

Degradation; Mathematical Models; Industrial Wastes; Heavy Metals

20030005945 Army Construction Engineering Research Lab., Champaign, IL USA

Evaluation of Galvanized and Galvalume/Paint Duplex Coating Systems for Steel Building Panels *Final Report*

Race, Timothy; Stephenson, L. D.; Kumar, Ashok; Feb. 2002; 33p; In English; Original contains color images

Contract(s)/Grant(s): DA Proj. 622784-AT-41

Report No.(s): AD-A408389; ERDC/CERL-TR-02-8; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Standing seam metal roofing systems are becoming increasingly popular because of lower life-cycle cost and aesthetic appeal. The coating systems most commonly used in metal roofs and metal buildings are galvanized or Galvalumed steel, factory-coated with polyvinylidene fluoride (PVF) or silicone modified polyester (SMP). Specimens having these coating systems were subjected to ASTM B 117, conventional salt spray exposure testing and ASTM D 5894 Testing in the laboratory, which combines the environmental effects of salt fog and ultraviolet exposure, alternately, and the results were compared. The ASTM D 5894 testing was used to simulate the typical corrosive atmospheric conditions of outdoor exposure. Electro-chemical impedance spectroscopy (EIS) of specimens exposed to ASTM D 5894 accelerated laboratory weathering provided a means of modeling the equivalent circuit parameters, and detecting the onset of incipient corrosion (coating degradation). Results show that both of these systems (galvanized vs. Galvalume) provide the same corrosion protection, and that EIS can be used to predict the long-term service life based on short-term field tests. Results indicated that ASTM D 5894 testing provides a better means of predicting real-world performance of a coating system than ASTM B 117.

DTIC

Metals; Corrosion Prevention; Coatings; Paints; Corrosion

20030006287 Wales Univ. Inst. of Science and Technology, Cardiff, UK

The Influence of Surface Treatments on Micropitting and Scuffing *Final Report*

Alanou, M. P.; Snidle, R. W.; Evans, H. P.; May 01, 2001; 31p; In English

Contract(s)/Grant(s): N68171-01-M-5370

Report No.(s): AD-A408484; ARDSG-R/D-9079-MS-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is the final report of the contract issued on 1 May 2001; this contract was a follow-on of contracts N68171-98-M-5294 and N68171-99-M-6457. Hence this report is based on an update of actions described in previous interim reports either covered by contracts N68171-98-M-5294, N68171-99-M-6457 or by the current contract. The focus of the current contract was on the scuffing performance of an ultra hard thin coating optimized for gearing applications. The original engineering background to this work was the need to understand the behavior and failure of gear tooth contacts used in demanding aerospace applications such as aircraft engine and helicopter gearboxes. Scuffing tests, designed to measure the performance of a particular combination of lubricant and gear steel, are usually impractical on full-scale machinery, while tests using smaller gears are expensive. Furthermore, it is difficult to measure quantities of interest for research purposes, such as friction and bulk temperature. Fundamental research investigations of scuffing under controlled conditions are therefore more conveniently carried out through the use of disc machines.

DTIC

Surface Finishing; Protective Coatings; Steels

20030006693 Lawrence Livermore National Lab., Livermore, CA USA

Correlating Observations of Deformation Microstructures by TEM and Automated EBSD Techniques

Kumar, M.; Schwartz, A. J.; King, W. E.; Jun. 05, 2000; 10p; In English

Report No.(s): DE2002-790920; UCRL-JC-137073; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The evolution of the deformed microstructure as a function of imposed plastic strain is of interest as it provides information on the material hardening characteristics and mechanism(s) by which cold work energy is stored. This has been extensively studied using transmission electron microscopy (TEM), where the high spatial and orientational resolution of the technique is used to advantage to study local phenomenon such as dislocation core structures and interactions of dislocations. With the recent emergence of scanning electron microscope (SEM) based automated electron backscatter diffraction (EBSD) techniques, it has now become possible to make mesoscale observations that are statistical in nature and complement the detailed TEM observations. Correlations of such observations will be demonstrated for the case of Ni-base alloys, which are typically noncell forming solid solution alloys when deformed at ambient temperatures. For instance, planar slip is dominant at low strain levels but evolves into a microstructure where distinct crystallographic dislocation-rich walls form as a function of strain and grain orientation. Observations recorded using both TEM and EBSD techniques are presented and analyzed for their implication on subsequent annealing characteristics.

NTIS

Electron Diffraction; Nickel Alloys; Scanning Electron Microscopy; Transmission Electron Microscopy; Backscattering; Cold Working; Crystallography

20030006710 Ames Lab., IA USA

Effect of Interstitial Impurities on the Magnetic Transitions of Er-rich Pr(x)Er(1-x)Alloys

Gschneidner, K. A.; Pecharsky, A. O.; Wu, Y. L.; Pecharsky, V. K.; Aug. 22, 2002; 20p; In English

Report No.(s): DE2002-802145; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Interstitial impurities (primarily oxygen, but also fluorine, nitrogen, and carbon) have a considerable effect on the magnetism of Er. They lower the second order magnetic transition temperatures (86 and 53 K), increase the first order magnetic transition temperature (19 K) and destroy the spin-slip magnetic transition (26 K) of pure Er. Similar trends are observed in the Pr(x)Er(1-x) alloys for 0 less than or equal to x less than or equal to 0.4. Pr additions to commercial grade Er and to high purity Er lower the two second order and spin-slip magnetic transition temperatures, and have little or no effect on the first order magnetic transition temperature for less than or equal to 0.125. The 52 and 22 K transitions are wiped-out by Pr additions of x 0.10 and x 0.02, respectively. Furthermore, the first order transition terminates in the concentration range 0.10 less than or equal to x less than or equal to 0.125, and a new magnetic phase is formed between 0.125 less than or equal to x less than or equal to 0.15. For x 0.35 the magnetic transitions merge and for larger Pr concentrations there is only one second order paramagnetic to antiferromagnetic transition on cooling.

NTIS

Magnetic Properties; Erbium; Interstitials; Impurities; Praseodymium; Transition Temperature

20030006729 Pittsburgh Univ., Dept. of Mechanical Engineering, Pittsburgh, PA USA

Impermeable thin Al₂O₃ Overlay for TBC Protection from Sulfate and Vanadate Attack in Gas Turbines *Quarterly Report, 1 Apr. - 30 Jun. 02*

2002; 14p; In English

Report No.(s): DE2002-800951; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In order to improve the hot corrosion resistance of conventional YSZ TBC system (YSZ/CoNiCrAlY/Inconel 601), an overlay Al₂O₃ was sprayed on the surface of TBC samples by high velocity oxy-fuel (HVOF) spray techniques. The TBC preparation in Japan was based on our technical requirement by plasma spray. Bond coat CoNiCrAlY and the YSZ was produced by low-pressure plasma spray and air plasma spray respectively. Hot corrosion tests were carried out on the TBC with and without Al₂O₃ coating in molten salts mixtures (Na₂SO₄ + 5% V₂O₅) at 950oC for 10h. The microstructures of TBC and overlay before and after exposure were examined by means of scanning electron microscopy (SEM), energy-dispersive X-ray spectrometer (EDX) and X-ray diffraction (XRD). It has been found that TBC reacted with V₂O₅ to form YVO₄. In the next period, the hot corrosion tests of TBC with EB-PVD Al₂O₃ coating under Na₂SO₄ + 5% V₂O₅ will be again performed at 950oC. However before hot corrosion tests, the post-annealing will be carried at 1273K for 1h in order to transform the as-sputtered gamma -Al₂O₃ overlay to crystalline alpha-Al₂O₃ overlay. In addition, the effect of coating thickness on corrosion resistance and the mechanisms of cracking of EB-PVD alumina layer during hot corrosion will be also investigated.

NTIS

Gas Turbines; Protective Coatings; Aluminum Oxides; Corrosion Resistance; Hot Corrosion; Corrosion Tests

20030006735 Lawrence Livermore National Lab., Livermore, CA USA

Effect of Thermal Aging the Corrosion Behavior of Wrought and Welded Alloy 22

Rebak, R. B.; Edgecumbe Summers, T. S.; Lian, T.; Carranza, R. M.; Dillman, J. R.; Jan. 02, 2002; 24p; In English

Report No.(s): DE2002-802917; UCRL-JC-146006; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Alloy 22 (UNS N06022) is a candidate material for the external wall of the high level nuclear waste containers for the potential repository site at Yucca Mountain. In the mill-annealed (MA) condition, Alloy 22 is a single face centered cubic phase. When exposed to temperatures on the order of 600DGC and above for times higher than 1 h, this alloy may develop secondary phases that are brittle and offer a lower corrosion resistance than the MA condition. The objective of this work was to age Alloy 22 at temperatures between 482 degrees C and 800 degrees C for times between 0.25 h and 3,000 h and to study the corrosion performance of the resulting material. Aging was carried out using wrought specimens as well as gas tungsten arc welded (GTAW) specimens. The corrosion performance was characterized using standard immersion tests in aggressive acidic solutions and electrochemical tests in multi-component solutions. Results show that, in general, in aggressive acidic solutions the corrosion rate increased as the aging temperature and aging time increased. However, in multi ionic environments that could be relevant to the potential Yucca Mountain site, the corrosion rate of aged material was the same as the corrosion rate of the MA material.

NTIS

Aging (Metallurgy); Annealing; Corrosion Resistance; Radioactive Wastes; Wrought Alloys; Temperature Effects

27

NONMETALLIC MATERIALS

Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.

20030005501 Strathclyde Univ., Glasgow UK

Non-Destructive Evaluation of Adhesive Bonded Structures Using Dielectric Methods *Final Report, 10 Aug. 2000-10 Aug 2002*

Pethrick, Richard; Aug. 2002; 6p; In English

Contract(s)/Grant(s): F61775-00-WE060

Report No.(s): AD-A408347; EOARD-SPC-00-4060; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This report results from a contract tasking University of Strathclyde as follows: The contractor shall characterize the dielectric signature of the hydrated lightly coated oxide surface, and investigate the effect of various solvent systems on bond durability. The contractor shall carry out aging studies using hydraulic fluid, aviation fluid, de-icing fluid and urea solutions to explore the way in which aging is influenced by these media. The outcome of this study shall be a definition of the rate and potential mechanisms of attack of these common fluids. The contractor shall characterize the aging of boron fiber/ epoxy aluminum bonded structures taking into account that the electrical conductivity of the boron fibers is intermediate between those of carbon and glass. As a result the approach to measurements used with either the carbon fibers or the aluminum structures is not appropriate with these structures. An electrode structure has been constructed which allows investigation of the dielectric properties of these structures, but the effects of moisture and aging in high humidity environments has not been evaluated. Structures have been created and it is planned to carry out aging studies over the next two years. Boron fiber composites are used in repair of damage on the skins of aluminum fabricated aircraft. This study will demonstrate the usefulness of the method for the characterization of aging in these bonded structures.

DTIC

Dielectric Properties; Adhesive Bonding; Nondestructive Tests

20030005554 Boston Univ., Dept. of Aerospace and Mechanical Engineering, Boston, MA USA

Rheology of Foam Near the Order-Disorder Phase Transition

Holt, R. Glynn, Boston Univ., USA; McDaniel, J. Gregory, Boston Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 165-166; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We introduce a unique method to provide non-contact control and manipulation of foam samples. The development of this technique will provide the ability to carry out a set of benchmark experiments in 0g allowing determination of a foam's yield stress, bulk shear and dilatational moduli and viscosities as a continuous function of gas volume (or void) fraction ϕ from the dry limit (ϕ approx. equal to 1) through the order-disorder phase transition to the wet limit (ϕ much less than 1) of a bubbly liquid. The goal of the investigation is the determination of the mechanical and rheological properties of foams, utilizing the microgravity environment to explore foam rheology for foams that cannot exist, or only exist for a short time, in 1g. The specific objectives of the investigation are: 1) to refine and utilize a novel, non-contact acoustic technique for experimentally measuring the stress-response of small samples of foam ('foam drops') subjected to both static and time-varying acoustic strain.

2) to experimentally measure the stress-response of foam drops subjected to both static and time-varying strain. 3) to model the response of foam drops to static and time-varying modulation of the acoustic field to extract rheological properties. 4) to define experiments that can be performed in the microg environment, where the effects of drainage, buoyancy and high acoustic fields can be avoided, and $\alpha(\text{sub } g)$ can be varied smoothly through the order-disorder transition. In the limit of dry foams (void fraction greater than the critical value, and approaching unity) and small deformations from equilibrium, we model foam as an effective elastic solid medium. We present a model for the normal modes of oscillation of an effective elastic sphere. By specifying (via measurement) the natural frequency of a specific mode we may infer the effective shear elastic modulus G of the foam. Results for a drop with void fraction of 0.8 yielded a shear modulus $G = 75 \pm 3$ Pa, which is of the same order as several estimates of the shear modulus of foams reported in the literature using contact-based techniques. Importantly, this result was insensitive to the foam's Poisson ratio, which is difficult to independently measure. Additional information is included in the original extended abstract.

Author

Rheology; Foams; Order-Disorder Transformations; Viscosity; Yield Strength; Microgravity

20030005615 NASA Glenn Research Center, Cleveland, OH USA

Granular Materials Research at NASA-Glenn

Agui, Juan H., NASA Glenn Research Center, USA; Daidzic, Nihad, National Center for Microgravity Research on Fluids and Combustion, USA; Green, Robert D., NASA Glenn Research Center, USA; Nakagawa, Masami, NASA Glenn Research Center, USA; Nayagam, Vedha, National Center for Microgravity Research on Fluids and Combustion, USA; Rame, Enrique, National Center for Microgravity Research on Fluids and Combustion, USA; Wilkinson, Allen, NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 609- 621; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This paper presents viewgraphs of granular materials research at NASA-Glenn. The topics include: 1) Impulse dispersion of a tapered granular chain; 2) High Speed Digital Images of Tapered Chain Dynamics; 3) Impulse Dispersion; 4) Three Dimensional Granular Bed Experimental Setup; 5) Magnetic Resonance Imaging of Fluid Flow in Porous Media; and 6) Net Charge on Granular Materials (NCharG).

CASI

Granular Materials; Research and Development; NASA Programs; Measuring Instruments

20030005659 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Orthotropic Mechanical Properties of Uncoated and Ceramic-Coated Uniaxially-Compressed Carbon Cellular Porous Materials

Barland, David; Aug. 15, 2001; 3p; In English; Pres: 43rd AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, 22-25 Apr 2002, Denver, CO

Report No.(s): AD-A408549; AFRL-PR-ED-AB-2001-172; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Porous cellular foams of moderate to high porosity (55%-95%) were investigated to determine orthotropic strength moduli and mechanical response. Uncoated porous samples consisted of reticulated vitreous carbon (RVC) rigidized by pyrolysis of flexible, open-pore organic precursor foams. The organic precursor's reference surface pore density was 100 pores-per-inch (ppi) before uniaxial compression. After compression, substrates contained 6% to 33% solid fraction, which corresponded in the thru-thickness direction to 200 ppi to 1100 ppi, respectively. Ceramic-overlaid samples were constructed by depositing silicon carbide (SiC) via chemical vapor infiltration (CVI) onto 600 ppi and 1000 ppi RVC substrates. The ceramic overlays added solid fractions of 5% and 12%, respectively. Compressive and tensile strengths were measured in-plane and thru-thickness for all materials. Results showed compressive crush strengths of the multi-layer porous materials to be bounded between theoretical strengths of solid RVC substrate and SiC-coated materials. Predictions from currently accepted cell anisotropy relations were compared to experiment and are shown to greatly over-predict the orthotropy due to uniaxial compression. The data may be applied to allow more precise design of components using ceramic-coated porous cellular materials.

DTIC

Mechanical Properties; Ceramic Coatings; Chemical Vapor Infiltration; Compressibility

20030005688 Houston Univ., Dept. of Chemical Engineering, TX USA

Protein-Precipitant-Specific Criteria for the Impact of Reduced Gravity on Crystal Perfection *Final Report, Jun. 1997 - Nov. 2001*

Vekilov, Peter G., Houston Univ., USA; [2003]; 8p; In English

Contract(s)/Grant(s): NAG8-1354; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The objective of this research is to provide quantitative criteria for the impact of reduced or enhanced convective transport on protein crystal perfection. Our earlier work strongly suggests that the magnitude of (lattice defect-inducing) fluctuations in the crystallization rate of proteins arise from the coupling of bulk transport and nonlinear interface kinetics. Hence, we surmised that, depending on the relative weight of bulk transport and interface kinetics in the control of the crystallization process on Earth, these fluctuations can either increase or decrease under reduced gravity conditions. The sign and magnitude of these changes depend on the specific protein-precipitant system. As a consequence, space environments can be either beneficial or detrimental for achieving structural perfection in protein crystals. The task objectives consist in systematic investigations of this hypothesis. Derived from text

Proteins; Microgravity; Crystallization

20030005865 NASA Langley Research Center, Hampton, VA USA

Investigation of Fundamental Modeling and Thermal Performance Issues for a Metallic Thermal Protection System Design

Blosser, Max L., NASA Langley Research Center, USA; [2002]; 18p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0503; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

A study was performed to develop an understanding of the key factors that govern the performance of metallic thermal protection systems for reUSABLE launch vehicles. A current advanced metallic thermal protection system (TPS) concept was systematically analyzed to discover the most important factors governing the thermal performance of metallic TPS. A large number of relevant factors that influence the thermal analysis and thermal performance of metallic TPS were identified and quantified. Detailed finite element models were developed for predicting the thermal performance of design variations of the advanced metallic TPS concept mounted on a simple, unstiffened structure. The computational models were also used, in an automated iterative procedure, for sizing the metallic TPS to maintain the structure below a specified temperature limit. A statistical sensitivity analysis method, based on orthogonal matrix techniques used in robust design, was used to quantify and rank the relative importance of the various modeling and design factors considered in this study. Results of the study indicate that radiation, even in small gaps between panels, can reduce significantly the thermal performance of metallic TPS, so that gaps should be eliminated by design if possible. Thermal performance was also shown to be sensitive to several analytical assumptions that should be chosen carefully. One of the factors that was found to have the greatest effect on thermal performance is the heat capacity of the underlying structure. Therefore the structure and TPS should be designed concurrently.

Author

Mathematical Models; Matrices (Mathematics); Performance Prediction; Sensitivity Analysis; Statistical Analysis; Temperature Effects; Thermal Analysis; Thermal Protection

20030005929 Honeywell, Inc., Plymouth, MN USA

PolyMEMS Actuator: A Polymer-Based Microelectromechanical (MEMS) Actuator with Macroscopic Action *Final Report, Jul. 1998-May 2002*

Horning, Robert; Sep. 2002; 83p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-C-0217; AF Proj. E117

Report No.(s): AD-A408325; AFRL-IF-RS-TR-2002-241; No Copyright; Avail: Defense Technical Information Center (DTIC)

A polymer-based MEMS actuator, consisting of small unit cells in a macroscopic array, was developed and demonstrated. Models were developed which predicted the performance, and actuators were fabricated which matched the theoretical predictions. Deformation due to imperfect assembly resulted in imperfect performance. Further work is required to develop a reliable assembly process. Numerous polymer-based fabrication procedures were developed. Many of them borrow from either silicon or flexible printed circuit manufacturing, but modifications were necessary in order to adapt the processes to MEMS. The actuator is very efficient and uses very little power, making it suitable for autonomous applications such as robots.

DTIC

Polymers; Actuators; Microelectromechanical Systems

20030005942 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Surface Studies of Space Survivable Hybrid Organic/Inorganic Polymers

Gonzalez, Rene I.; Svejda, Steven A.; Phillips, Shawn H.; Hoflund, Gar B.; Apr. 12, 2001; 3p; In English; Prepared in cooperation with Univ. of Florida, Gainesville, FL. Presented at the American Chemical Society Meeting. Held in Chicago, IL, 26 Aug 2001
Contract(s)/Grant(s): AF Proj. 2303

Report No.(s): AD-A408386; AFRL-PR-ED-AB-2001-083; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The aggressive conditions present in low-Earth orbit (LEO) reduce the longevity of organic materials used in the construction of space vehicle thereby restricting the number of available space-certified polymers. Many studies have been conducted in an effort to determine the degradation mechanism of polymeric materials primarily caused by surface reactions with atomic oxygen (AO), the predominant species in LEO. However, these studies were carried out after exposing these highly reactive surfaces to air prior to analysis, thus introducing artifacts not generated in the space environment. Recent testing of polymers containing the nanostructured Si-O frameworks known as POSS (polyhedral oligomeric silsesquioxanes) has shown these materials to have promising AO resistant properties. The polymers were exposed to AO produced by a hyperthermal oxygen atom source capable of producing a neutral, steady state flux of AO comparable to the actual LEO environment. In-situ XPS analysis reveals that POSS-polymers rapidly form a glassy, passivating SiO₂ layer preventing further degradation of the underlying polymer. This presentation will focus on the synthesis, AO testing and subsequent materials characterization of hybrid POSS polymers including POSS-PDMS, POSS-polyurethane, POSS-polyimide and POSS-polyolefin copolymers.

DTIC

Degradation; Aerospace Environments; Polymers

20030006090 Air Force Research Lab., Materials and Manufacturing Directorate, Tyndall AFB, FL USA

Evaluation of Volatile Organic Compound Emissions from Line-X XS-350 Polymer Coating *Final Report, Jan. 1999-Aug. 2000*

Henley, M. V.; Weber, R. M.; Nov. 2002; 11p; In English

Contract(s)/Grant(s): F06637-98-C-6002; AF Proj.4915

Report No.(s): AD-A408296; AFRL-ML-TY--TR-2002-4608; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of Line-X XS-350 polymer as an interior retrofit coating for occupied building Structures to improve their blast resistance has raised a major concern by potential users of the polymer retrofit technology. That concern is if any volatile organic emissions off-gas from the curing polymer and if so are they within permissible exposure limits. This study addresses those concerns by conducting the pertinent tests and/or analyses to document the emissions and potential health and safety aspects of Line-X XS-350.

DTIC

Polymers; Coating; Curing

20030006256 Universidad Politecnica de Madrid, Escuela Tecnica Superior de Ingenieros de Caminos, Madrid, Spain

Characterization of Fraglight Non-Woven Felt and Simulation of FSP's Impact in it *Final Report*

Chocron, Sidney; Pintor, A.; Cendon, D.; Rosello, C.; Sanchez-Galvez, V.; Sep. 12, 2002; 59p; In English

Contract(s)/Grant(s): N68171-01-M-5983

Report No.(s): AD-A408250; ARDSG-R/D-8927-AN-01; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The non-woven felt known commercially as Dyneema Fraglight has an outstanding performances stopping fragments. The objective of this project is to understand the reason for this performance by means of four different approaches: 1) Through mechanical characterization varying size, direction, temperature and strain rate of specimens; 2) Ballistic characterization to obtain residual velocity curves and high speed photography; 3) Numerical simulations of static and ballistic tests; 4) Analytical modeling. All the approaches were covered, although the analytical work would need more work to complete. The mechanical characterization has shown that the felt is orthotropic, very size dependent, that it weakens appreciably at 100 C and up to strain rates of 10(exp 3)S(exp -1) its properties do not suffer a large modification. The ballistic tests show that the felt is actually better than what the manufacturer claims (with the boundary conditions used in this project) . The numerical simulations confirm that the huge deformation suffered by the felt during the ballistic impact is the key for its outstanding performance. An analytical simulation of a non-homogenous, non-linear and under very high strains is extremely difficult from first principles, though a constitutive equation for an elastic, orthotropic fibrous material, with arbitrary distribution of fibers has been developed.

DTIC

Fibers; Mechanical Properties; Strain Rate; Terminal Ballistics

20030006264 NASA Langley Research Center, Hampton, VA USA

Preliminary Thermal-Mechanical Sizing of Metallic TPS: Process Development and Sensitivity Studies

Poteet, Carl C., NASA Langley Research Center, USA; Abu-Khajeel, Hasan, Lockheed Martin Space Systems Co., USA; Hsu, Su-Yuen, Lockheed Martin Space Systems Co., USA; [2002]; 17p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0505; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The purpose of this research was to perform sensitivity studies and develop a process to perform thermal and structural analysis and sizing of the latest Metallic Thermal Protection System (TPS) developed at NASA LaRC (Langley Research Center). Metallic TPS is a key technology for reducing the cost of reUSable launch vehicles (RLV), offering the combination of increased durability and competitive weights when compared to other systems. Accurate sizing of metallic TPS requires combined thermal and structural analysis. Initial sensitivity studies were conducted using transient one-dimensional finite element thermal analysis to determine the influence of various TPS and analysis parameters on TPS weight. The thermal analysis model was then used in combination with static deflection and failure mode analysis of the sandwich panel outer surface of the TPS to obtain minimum weight TPS configurations at three vehicle stations on the windward centerline of a representative RLV. The coupled nature of the analysis requires an iterative analysis process, which will be described herein. Findings from the sensitivity analysis are reported, along with TPS designs at the three RLV vehicle stations considered.

Author

Sensitivity Analysis; Thermodynamics; Thermal Analysis; Structural Analysis; Thermal Protection

20030006708 Pacific Northwest National Lab., Richland, WA USA

Batch Reactions of a Soda-Lime Silicate Glass

Kim, D. S.; Matyas, J.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-15001103; PNNL-13994; No Copyright; Avail: National Technical Information Service (NTIS)

The purpose of this project is to develop the batch reaction data for a soda-lime-silicate glass needed to improve the batch part of the glass-furnace model being developed for the glass industry. Evolved gas analysis combined with batch expansion measurement and thermal analysis was successfully applied to obtain batch reaction data. The heat-capacity measurement by differential scanning calorimetry (DSC) was suggested as a promising method to derive the heat-of-fusion data inexpensively for many different technical glass batches. More tests on a variety of glass batches and parametric studies of the suggested methods are needed for validation. The experimental methods for batch reaction studies and the methodology for obtaining inexpensive heat-of-fusion data developed in this study can also be applied to various types of other technical glasses.

NTIS

Calcium Oxides; Glass; Industries; Silicates; Heat Measurement

20030006709 Pacific Northwest National Lab., Richland, WA USA

Thermochemical Optimization of Float Glass Composition: Low-Alumina Glass Development

Hrma, P. R.; Smith, D. E.; Yeager, J. D.; Lam, O. P.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-15001100; PNNL-13958; No Copyright; Avail: National Technical Information Service (NTIS)

The liquidus temperature was measured for a float-glass-type composition region with 72.7 to 74.0 mass% SiO₂, 0.1 to 0.45 mass% Al₂O₃, 8.0 to 9.0 mass% CaO, 3.0 to 4.0 mass% MgO, and 13.1 to 14.2 mass% Na₂O. Crystalline phases were identified at 900 deg C as cristobalite, wollastonite, and devitrite. The primary phases were tridymite and wollastonite. Partial specific liquidus temperatures were obtained from the data and compared with the literature.

NTIS

Glass; Thermochemistry; Aluminum Oxides; Floats

20030006758 Dayton Univ. Research Inst., Research Inst., OH USA

The Evaluation of Ambient-Temperature Processes for Repair Bonding of Aluminum Alloys Interim Report, 1 Jan. 2000-30 Dec. 2001

McCray, Daniel B.; Jan. 2002; 33p; In English

Contract(s)/Grant(s): F33615-00-D-5600; Proj-4349

Report No.(s): AD-A408217; UDR-TR-2002-00020; AFRL-ML-WP-TR-2002-4043; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

On-aircraft adhesive bonding of metal substrates typically requires the use of impractical surface preparation processes in order to attain the desired bonded joint strength and durability. Surface preparations currently used for on-aircraft repairs rely on hazardous materials and/or inconvenient processing steps, or they do not yield adequate bond performance. Many U.S. Air Force Technical Orders (T.O.s) require the use of surface preparations such as phosphoric acid anodize (PAA) or acid paste etches for the repair of aluminum alloy structure. These surface preparations are often impractical due to difficulties imposed by the use of aircraft use of acids or the extended time required for their application. The phosphoric acid in PAA and sulfuric acid used in common paste acid etches are difficult to contain and can embrittle certain high-strength steels'. In addition, the acids must be rinsed after application and could cause corrosion of metallic structure if not completely removed. The grit-blast/silane surface preparation employed in many repair applications provides an alternative to the use of acids but requires a grit-blasting step, elevated-temperature drying, and several hours to perform. The use of hazardous materials in these surface preparations is becoming more difficult due to existing and proposed environmental and health regulations. The combination of these regulations and the need to reduce environmental waste stream while maintaining adequate bond performance has led to the development of more environmentally friendly processes.

DTIC

Aluminum Alloys; Hazardous Materials; Adhesive Bonding

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PROPELLANTS AND FUELS

Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.

20030005672 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Predicting the Initial Crack Length in a Solid Propellant

Liu, C.T.; Kwon, Y. W.; Hendrickson, T. L.; Oct. 20, 2000; 3p; In English

Report No.(s): AD-A408146; AFRL-PR-ED-AB-2000-226; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

In this study, a micro-macromechanical approach was used to predict the initial crack length near the edge of the hole in solid propellant specimens. The approach was based on a simplified micromechanical model, damage mechanics at the micro-level, and finite element analysis at the macro-level. Both micromechanical and macromechanical analyses were conducted in tandem. The developed technique together with a mechanistic criterion was used to predict the initial crack length in high stress regions. The criterion was based on the instability of the damaged material just ahead of the crack tip. The initial crack length is equal to the length of unstable material zone when the damage at the crack tip element is saturated. Based on the definition of the initial crack length and the micro-macromechanical approach, the initial crack lengths in the high stress regions were predicted. The predicted initial crack lengths and the experimentally measured values were compared and the results were discussed.

DTIC

Micromechanics; Solid Propellants; Crack Propagation; Damage

20030005705 NASA Glenn Research Center, Cleveland, OH USA

Combustion Research Aboard the ISS Utilizing the Combustion Integrated Rack and Microgravity Science Glovebox

Sutliff, Thomas J., NASA Glenn Research Center, USA; Otero, Angel M., NASA Glenn Research Center, USA; Urban, David L., NASA Glenn Research Center, USA; November 2002; 12p; In English; 53rd International Astronautical Congress, 10-19 Oct. 2002, Houston, TX, USA; Sponsored by International Astronautical Federation, Unknown; Original contains color illustrations Contract(s)/Grant(s): RTOP 400-35-8A

Report No.(s): NASA/TM-2002-211998; NAS 1.15:211998; E-13670; IAC-02-T.4.05; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Physical Sciences Research Program of NASA sponsors a broad suite of peer-reviewed research investigating fundamental combustion phenomena and applied combustion research topics. This research is performed through both ground-based and on-orbit research capabilities. The International Space Station (ISS) and two facilities, the Combustion Integrated Rack and the Microgravity Science Glovebox, are key elements in the execution of microgravity combustion flight research planned for the foreseeable future. This paper reviews the Microgravity Combustion Science research planned for the International Space Station implemented from 2003 through 2012. Examples of selected research topics, expected outcomes, and potential benefits will be provided. This paper also summarizes a multi-user hardware development approach, recapping the progress made in preparing these research hardware systems. Within the description of this approach, an operational strategy is

presented that illustrates how utilization of constrained ISS resources may be maximized dynamically to increase science through design decisions made during hardware development.

Author

Combustion; Combustion Physics; Spaceborne Experiments; Microgravity; Fire Prevention; Spacecraft Environments; Evolvable Hardware

20030005943 Thiokol Propulsion, Brigham City, UT USA

Modern SRM Ignition Transient Modeling, Part 4, Development of the Structural/Ballistic Analysis System SBAS-II

Graham, Robert P.; Iverson, Michael P.; Jan. 19, 2001; 3p; In English; Pres. at AIAA Joint Propulsion Conference (37th). Held in Salt Lake City, UT, 8-11 Jul 2001

Contract(s)/Grant(s): F04611-99-C-0002; AF Proj. 1011

Report No.(s): AD-A408387; AFRL-PR-ED-AB-2001-014-Pt-4; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Development continues on a system of computer codes for modeling propellant grains during ignition and burning, including the possibility of flaw initiation and growth. This system is known as the Structural/Ballistic Analysis System, or SBAS. It comprises a collection of separate computer codes which each address a different aspect of motor operation, including structural deformation, propellant burn-back, internal ballistics, gas flow, fracture propagation, and crack combustion. At the heart of the SBAS is an executive module that interfaces with each of the individual analysis codes transfers data from one to another, maintains a central module database. and includes model generation and examination functions.

DTIC

Computerized Simulation; Propellant Grains

20030006095 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Predicting Crack Growth Behavior in a Filled Polymeric Material

Liu, C. T.; Jun. 1999; 15p; In English; Viewgraphs only. Pres. at 1999 ASME Summer Conference

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408400; AFRL-PR-ED-TP-99-0135; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Viewgraphs for presentation of findings on predicting crack growth behavior in a filled polymeric material.

DTIC

Crack Propagation; Polymers; Mechanical Properties; Conferences

20030006098 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Mode Mixity Determinations for Interfacial Cracking in Incompressible Materials Under Plane Strain Conditions

Miller, T. C.; Oct. 1998; 18p; In English; Prepared in collaboration with Virginia Polytechnic Inst. and State University, Blacksburg, VA

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408405; AFRL-PR-ED-TP-1998-169; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Presentation slides for conference lecture on mode mixity determinations for interfacial cracking in incompressible materials under plane strain conditions.

DTIC

Conferences; Cracking (Fracturing); Plane Strain; Interfacial Tension

20030006099 Air Force Research Lab., Edwards AFB, CA USA

Fracture Mechanics of Solid Propellants

Liu, C. T.; Dec. 1999; 22p; In English; Presented at JANNAF Propulsion Meeting (49th). Held in Tucson, AZ, 14-16 Dec 1999

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408407; AFRL-PR-ED-TP-99-0231; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Presentation slides for conference lecture on fracture mechanics of solid propellants.

DTIC

Conferences; Fracture Mechanics; Solid Propellants; Mechanical Properties

20030006101 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Damage Analysis for Mixed-Mode Crack Initiation

Wei, Y.; Chow, C. L.; Liu, C. T.; Aug. 01, 2000; 16p; In English; Viewgraphs only. Prepared in collaboration with Univ. of Michigan-Dearborn, Dearborn, MI. Pres. at Int. Conference on Computational Science. Held in Anaheim, CA, 21-25 Aug 2000

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408409; AFRL-PR-ED-TP-2000-158; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
Presentation slides with findings of damage analysis for mixed-mode crack initiation study.

DTIC

Crack Initiation; Damage Assessment; Composite Propellants; Mechanical Properties

20030006104 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Application of Real-Time X-Ray Technique to Monitor Damage Process in a Particulate Filled Elastomer

Liu, C. T.; Aug. 1999; 15p; In English

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408415; AFRL-PR-ED-TP-99-0171; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Presentation slides for international conference lecture on the application of real time X-ray techniques to monitor the damage process in a particulate filled elastomer.

DTIC

Damage; Elastomers; Particulates; Real Time Operation; X Rays; Conferences

20030006105 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Influence of Near Tip Damage on the Initiation Fracture Toughness of a Particulate Composite

Liu, C. T.; Miller, T.; Jun. 1999; 18p; In English; Presented at 1999 ASME Summer Conference

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408416; AFRL-PR-ED-TP-99-0134; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Presentation slides for conference lecture on the influence of near tip damage on the initiation fracture toughness of a particulate composite.

DTIC

Crack Initiation; Fracture Strength; Particulates; Crack Tips; Toughness; Composite Materials

20030006108 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Investigating Near Tip Damage and Crack Growth Behavior in a Solid Propellant

Liu, C. T.; Oct. 2000; 3p; In English; Presented at JANNAF Joint Meeting. Held in Cocoa Beach, FL, 26-30 Mar 2001

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408422; AFRL-PR-ED-AB-2000-224; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

When cracks occur, whether resulting from the manufacturing process or from service loads, the stresses near the crack tip will be redistributed according to nonlinear material behavior. Depending on the magnitude of the local stresses and the local strength, various defects, microvoids or microcracks, can develop in the crack tip region. And, depending on the severity of these defects, crack growth behavior can be significantly affected. Therefore, to obtain a fundamental understanding of crack growth behavior in particulate composite materials, the effect of the defect on local fracture behavior near the crack tip needs to be determined. In recent years, a considerable amount of work has been done studying crack growth behavior in particulate composite materials. This work was based on linear elastic or viscoelastic fracture mechanics. The principles of classical fracture mechanics are well established for single-phase materials. However, experimental evidence indicates that linear fracture mechanics theories have been applied to particulate composite materials with varying degrees of success. In this study, pre-cracked specimens were used to study local damage near the crack tip and crack growth behavior in a solid propellant under a constant strain rate at room temperature. The local damage state and its effect on crack growth behavior were investigated and the results were discussed.

DTIC

Crack Propagation; Crack Tips; Fracture Mechanics; Solid Propellants; Viscoelasticity

20030006109 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

An Experimental Investigation of Cracking Along a Liner-Propellant Interface

Miller, Tim; Oct. 2000; 3p; In English; Presented at JANNAF 34th Structures and Mechanical Behavior Subcommittee Meeting. Held in Cocoa Beach, FL, 20-26 Mar 2001

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408423; AFRL-PR-ED-AB-2000-225; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The fracture of a liner-propellant interface is studied experimentally using a tensile testing apparatus and videotape equipment. Additional experimental methods are used to supplement the conclusions derived from this testing, and computational modeling of the specimens is also performed. The fracture of the bimaterial is governed by the mode mixity and the properties

of the constituents, and may involve crack growth along the interface or branching of the crack away from the interface, depending on the specific conditions.

DTIC

Linings; Propellants; Fracture Mechanics; Cracking (Fracturing)

20030006111 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Stress Intensity Factors for Cracks Within and Near to Bondlines in Soft Incompressible Materials

Smith, C. W.; Gloss, K. T.; Constantinescu, D. M.; Liu, C. T.; Apr. 2000; 11p; In English; Prepared in collaboration with Virginia Polytechnic Inst. and State Univ., Blacksburg, VA. Pres. at 2000 ASME Int. Mechanical Engineering Congress. Held in Orlando, FL, 5-10 Nov 2000

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408427; AFRL-PR-ED-TP-2000-067; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using a polyurethane photoelastic material, thick test specimens of several configurations with bonded end tabs are examined for measuring stress intensity factors (SIFs) for cracks within and near to bondlines in bonded photoelastic models. Effects of specimen height, glued end tabs, bondline and crack size and location are studied and analyzed using a two parameter model for extracting the SIFs and results are compared with cracked, homogeneous model results.

DTIC

Cracks; Photoelastic Materials; Polyurethane Resins; Stress Intensity Factors; Incompressibility

20030006252 Department of Defense, Office of the Inspector General, Arlington, VA USA

Environment: DoD Alternative Fuel Vehicle Program

Nov. 22, 2002; 41p; In English

Report No.(s): AD-A408259; IG/DOD-D-2003-025; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The USA uses more petroleum each year than the next five largest consuming nations combined. The Federal Government is the largest single consumer of energy in the USA, with DoD consuming about 80 percent of the Federal Government total. Over 40 percent of the energy use is for buildings and non-tactical vehicles. In FY 2000, DoD consumed 4.5 billion gallons of aviation, marine, and ground fuels, including 200 million gallons of gasoline and diesel fuels. In May 2001, the President's National Energy Policy Development Group released the report titled "National Energy Policy," which identified the ability to use energy more wisely through conservation as one of three energy challenges to our prosperity and way of life.

DTIC

Military Vehicles; Aircraft Fuels

20030006266 NASA Marshall Space Flight Center, Huntsville, AL USA

Propellant Densification for Shuttle: The SSME Perspective

Greene, William D., NASA Marshall Space Flight Center, USA; Boxx, Dayna L., NASA Marshall Space Flight Center, USA; May 20, 2002; 14p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-3602; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The subject of cryogenic propellant densification as a potential upgrade to the Space Shuttle is a subject that has been raised on several occasions over the last decade. Due to advancements in densification technology made as a part of and in parallel to the X-33 project, the subject was raised and studied once again in May 2001. Across the Space Shuttle program people from many disciplines converged to discuss issues and perform trade studies to determine whether densified propellants was worth pursuing. This paper discusses one of these areas, specifically the Space Shuttle Main Engine (SSME). The effects of propellant densification on steady state performance are presented along with discussions of potential transient performance issues. Engine component redesign and retrofit issues are discussed as well the high level requirements to modify the ground test stands to accommodate propellant densification hardware and tanks. and finally, the matter of programmatic concerns enters the subject at hand as part of a discussion of SSME recertification requirements. In the end, potential benefits to SSME performance can be demonstrated and, subject to the densification scheme chosen, there does not appear to be insurmountable technical obstacles.

Author

Space Shuttle Main Engine; Cryogenic Rocket Propellants

20030006267 NASA Marshall Space Flight Center, Huntsville, AL USA

Oxidizer Selection for the ISTAR Program (Liquid Oxygen versus Hydrogen Peroxide)

Quinn, Jason Eugene, NASA Marshall Space Flight Center, USA; [2002]; 14p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4206; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

This paper discusses a study of two alternate oxidizers, liquid oxygen and hydrogen peroxide, for use in a rocket based combined cycle (RBCC) demonstrator vehicle. The flight vehicle is baselined as an airlaunched self-powered Mach 0.7 to 7 demonstration of an RBCC engine through all or its air breathing propulsion modes. Selection of an alternate oxidizer has the potential to lower overall vehicle size, system complexity/ cost and ultimately the total program risk. This trade study examined the oxidizer selection effects upon the overall vehicle performance, safety and operations. After consideration of all the technical and programmatic details available at this time, 90% hydrogen peroxide was selected over liquid oxygen for use in this program.

Author

Oxidizers; Air Breathing Engines; Hydrogen Peroxide; Rocket-Based Combined-Cycle Engines

20030006695 Wyoming Univ., Western Research Inst., Laramie, WY USA

Petroleum Residua Solubility Parameter/Polarity Map: Stability Studies of Residua Pyrolysis Final Report

Schabron, J. F.; Pauli, A. T.; Rovani, J. F.; Apr. 1999; 34p; In English

Report No.(s): DE2002-778911; WRI-99-R004; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of the present study was to develop a mapping tool that will enhance understanding of the changes that occur in residua during upgrading and support the industry sponsored work in which Western Research Institute is engaged. WRI performs proprietary industry sponsored residua and heavy oil upgrading process development and optimization research. The new mapping tool can be used for evaluating heavy oils and residua in both upstream and downstream operations.

NTIS

Asphaltenes; Pyrolysis; Solubility

20030006707 National Renewable Energy Lab., Golden, CO USA

Lignocellulosic Biomass to Ethanol Process Design and Economics Utilizing Co-Current Dilute Acid Prehydrolysis and Enzymatic Hydrolysis for Corn Stover

Aden, A.; Ruth, M.; Ibsen, K.; Jechura, J.; Neeves, K.; Jun. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-15001119; NREL/TP-510-32438; No Copyright; Avail: National Technical Information Service (NTIS)

The U.S. Department of Energy (DOE) is promoting the development of ethanol from lignocellulosic feedstocks as an alternative to conventional petroleum-based transportation fuels. DOE funds both fundamental and applied research in this area and needs a method for predicting cost benefits of many research proposals. To that end, the National Renewable Energy Laboratory (NREL) has modeled many potential process designs and estimated the economics of each process during the last 20 years. This report is an update of the ongoing process design and economic analyses at NREL. We envision updating this process design report at regular intervals; the purpose being to ensure that the process design incorporates all new data from NREL research, DOE funded research and other sources, and that the equipment costs are reasonable and consistent with good engineering practice for plants of this type. For the non-research areas this means using equipment and process approaches as they are currently used in industrial applications.

NTIS

Biomass; Ethyl Alcohol; Design Analysis; Crude Oil

29 SPACE PROCESSING

Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see 84 Law, Political Science and Space Policy.

20030005532 Notre Dame Univ., Dept. of Physics, IN USA

Diffusive Coarsening of Liquid Foams in Microgravity

Veretennikov, Igor N., Notre Dame Univ., USA; Glazier, James A., Notre Dame Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 9-10; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Our main goal is to simulate, to some extent, microgravity conditions in the presence of gravity, to check the stages of a proposed scenario for coarsening of "space" foams, and to determine relations between foam structure and wetness and rheological properties. Our current focus is on preliminary experiments needed for MRI studies of stabilized foam: optimization of the foam's composition, of imaging parameters and the investigation of foam stability against global convection. To mimic foam behavior under microgravity, we stabilize the foam by supplying extra fluid on the top of the foam head. While this fluid increases the MRI signal, it also creates some extra problems. Although the Plateau borders have no breaks and are well resolved, the image is noisy and difficult to analyze. Noise sources include: 1) higher water content increases the signal from the membranes, which registers as noise since the membranes remain unresolved. 2) The extra flow in the membranes creates ghosts in the images due to phase errors. 3) The weak signal from the Plateau borders is averaged over a large voxel volume. To understand the relative importance of each noise source and to find an effective way to eliminate or reduce it, we conducted several series of experiments with solid gelatin-based foams. We make the foam from a heated gelatin-water solution and cool it immediately after foam generation.

Author

Diffusivity; Foams; Microgravity; Rheology; Liquids; Coarseness

20030005541 Cincinnati Univ., Dept. of Chemical Engineering, OH USA

Development of a New Membrane Casting Apparatus for Studying Macrovoid Defects in Low-G

Lee, Hanyong, Cincinnati Univ., USA; Hwang, Sun-Tak, Cincinnati Univ., USA; Krantz, William B., Cincinnati Univ., USA; Greenberg, Alan R., Colorado Univ., USA; Khare, Vivek, Colorado Univ., USA; Zartman, Jeremiah, Colorado Univ., USA; Todd, Paul W., Space Hardware Optimization Technology, Inc., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 77-86; In English; Also announced as 20030005526; Original contains color illustrations

Contract(s)/Grant(s): NAG3-2451; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A new membrane-casting apparatus is developed for studying macrovoid defects in polymeric membranes made by the wet- and dry-casting process in low-gravity. Macrovoids are large (10-50 micron), open cavities interspersed among the smaller pores in the substructure under the gelled skin surface layer of the cast membrane. Although their occurrence is considered endemic to the wet- and dry-casting process since they can lead to compaction or skin rupture in the membrane process, recent studies suggest several useful applications such as transdermal and osmotic drug delivery systems, miniature bioreactors, etc. However, lack of knowledge about the macrovoid formation mechanism is an obstacle to further development of applications using them. An on-going debate is the role of the surface-tension-driven solutocapillary convection during macrovoid formation. The rapid growth of macrovoids within 1-5 seconds and the high polymer concentration in and near macrovoids make it difficult to explain the mechanism of macrovoid growth by diffusion alone, which is the widely accepted hypothesis proposed by Reuvers et al. The hypothesis advanced by our research group can explain this rapid growth via a mechanism that involves diffusion from the casting solution in the meta-stable region to the macrovoid enhanced by solutocapillary convection induced by the steep nonsolvent concentration gradient in the vicinity of the macrovoid. Since macrovoid growth is hypothesized to be the interplay of a solutocapillary-induced driving force counteracted by viscous drag and buoyancy, eliminate the latter provides a means for testing this hypothesis. Moreover, free convection mass transfer in the nonsolvent immersion bath used to cause phase-separation in membrane casting complicates developing a model for both the wet-casting process and macrovoid growth. The low-g environment minimizes gravitationally induced free convection thereby permitting a tractable solution to the ternary diffusion equations that characterize membrane formation. NASA's Parabolic Flight Research Aircraft provides a small window of low-g (approximately 25 s) that can be used to study macrovoid development in both wet- and dry-cast membranes if an appropriate casting apparatus is used. This casting apparatus should be able to cast the membrane in both low- and high-g in a manner so that essential one-dimensional mass transfer conditions are achieved to insure lateral uniformity in the membrane. The apparatus used

in previous research on membrane casting in low-gravity was operated with the plunger driven mechanism. The spring-loaded plunger pushes the bottom block containing the polymer casting solution well directly under the absorbent chamber located in the upper stationary block. However, membranes made via this casting apparatus often displayed lateral nonuniformities that precluded obtaining quantitative information on the macrovoid growth process. Thus, it was necessary to determine the reason for these structural irregularities observed in the low-g casting apparatus. Both experimental as well as computer simulation studies of the low-g casting apparatus established that the impulsive action of the plunger caused the undesired structural nonuniformities. The simulation results showed that the width-to-depth aspect ratio of the shallow well that contains the casting solution in this apparatus was not an important factor in minimizing this problem. Even for a 40:1 (width : depth) aspect ratio, any convection induced by the horizontal motion of the interface of the casting solution will be damped out within 6.25×10^4 seconds. However, the experimental studies revealed that the impulsive motion of the plunger caused a 'sloshing' of the casting solution that had to be eliminated. Therefore, the plungerdriven mechanism was changed to a cam-driven mechanism that did not cause any impulsive motion of the casting solution. Other refinements to this new membrane-casting apparatus include provision for removing the membranes from the casting wells in a less destructive manner. This was accomplished by using a slit geometry for the casting well that permitted disassembly for removal of the cast membrane. The materials used in the construction of this casting apparatus were chosen to insure wetting at the side walls and to maintain precise control of the thickness of the polymer solution in the casting well. An additional provision in this new casting apparatus is the ability to carry out both wet- as well as dry-casting. As such, this apparatus permitted the first studies of the wet-casting of polymeric membranes in low-g. Both wet- and dry-casting experiments on NASA's KC-135 research aircraft employing this new membrane-casting apparatus are scheduled in July 2002. The morphology of the resulting membranes will be characterized using an environmental scanning electron microscope (ESEM). The results of these low-g studies will be reported later.

Author

Casting; Membrane Structures; Polymer Blends; Microgravity; Defects; Fluid Dynamics; Viscous Drag; Buoyancy-Driven Flow; Gas-Liquid Interactions

20030005542 Michigan Univ., Ann Arbor, MI USA

Using Nonlinearity and Contact Lines to Control Fluid Flow in Microgravity

Perlin, M., Michigan Univ., USA; Schultz, W. W., Michigan Univ., USA; Bian, X., Michigan Univ., USA; Agarwal, M., Michigan Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 87-98; In English; Also announced as 20030005526; Original contains color illustrations

Contract(s)/Grant(s): NAG3-2406; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Slug flows in a tube are affected by surface tension and contact lines, especially under microgravity. Numerical analyses and experiments are conducted of slug flows in small-diameter tubes with horizontal, inclined and vertical orientations. A PID-controlled, meter-long platform capable of following specified motions is used. An improved understanding of the contact line boundary condition for steady and unsteady contact-line motion is expected. Lastly, a direct fluid-handling method using nonlinear oscillatory motion of a tube is presented.

Author

Fluid Flow; Fluid Management; Microgravity; Boundary Conditions; Liquid-Solid Interfaces; Nonlinearity; Oscillations; Fluid Dynamics

20030005546 Battelle Memorial Inst., Richland, WA USA

Microchannel Phase Separation and Partial Condensation in Normal and Reduced Gravity Environments

TeGrotenhuis, Ward E., Battelle Memorial Inst., USA; Stenkamp, Victoria S., Battelle Memorial Inst., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 122-123; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Microtechnology was conceived as a means of shrinking the length scales of heat and mass transfer to 100 microns or less so that orders of magnitude increases in throughput can be realized in chemical processes. The subsequent reduction in size and mass lends itself well to space applications. Using proprietary sheet architecture, Battelle has created such devices with micro chemical and thermal systems (MicroCATS) for gas phase reactions, heat transfer and solvent extraction. In this work, Battelle has extended the technology to include phase separation and partial condensation with phase separation in channels between 100 microns and a few millimeters at the smallest dimension. These length scale channels are advantageous for all reduced gravity applications involving two-phase flow since hydrodynamic, interfacial and capillary forces dominate over gravitational forces. by controlling the wettability and porosity of the materials within the device, separation occurs spontaneously thus allowing high throughputs and easy recovery from process upsets. Enhanced heat transfer in the case of condensation is obtained through

reduction of the narrowest channel dimension. Scale up is achieved by simply increasing the number of layers. Potential space applications for phase separation and condensation include water management in environmental control and life support and thermal systems involving phase change (heat pipes, vapor compression cycles). These devices are also well suited for in-situ resource utilization or 'living off the land' since they are compact and efficient. Applications include phase separation and condensation of water during in-situ propellant production.

Author

Two Phase Flow; Microgravity; Phase Separation (Materials); Phase Transformations; Nanotechnology; Condensing; Fluid Dynamics

20030005547 Portland State Univ., OR USA

Capillary Flow in Interior Corners

Weislogel, Mark M., Portland State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 124; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Capillary flows in interior corners have an established place in fluids-handling operations in reduced gravity environments. A quantitative understanding of corner flows is essential for the myriad fluid management tasks in space including flows in liquid-fuel tanks, thermal control systems, and life-support systems. Though low-g fluid system designs are 'largely successful,' current techniques for predicting system performance are primarily limited to order of magnitude estimates, delicately guided by the experience of the designer, or direct numerical simulation which can be prohibitively time consuming. Highly reliable and quantitative design tools serving between these extremes are welcome contributions to the low-g fluids management community. In this research effort, an asymptotic analysis developed and benchmarked for capillary flows in simplified containers possessing interior corners is generalized and broadly applied to flows in containers and/or corner geometries of increasing complexity. Closed form solutions to important problems such as interior corner transient flow rates, local and global flow characteristics, interface profiles, and stability are determined for a variety of container types and boundary conditions. A partial list of problems addressed includes flows in corners of infinite extent, regular and irregular polygonal cylinders, and complex 'vaned' containers modeling propellant management devices in liquid fuel tanks. Other complicating conditions such as nonplanar corners, out-of-plane corners, helical corners, background accelerations, heat and mass transfer, and interfacial shear are addressed. Applications of the results to low-g fluid system design and analysis are manifold and an excellent example is provided by way of a post-analysis of NASA's Vented Tank Resupply Experiment performed on the shuttle in 1996. Extensive drop tower and low-g aircraft experiments are performed to guide and/or support the development and application of the most fundamental aspects of the theory. For the special case of steady capillary driven flow the analysis is readily extended to complex corner networks modeling macroscale flows within intricately vaned containers in space as well as microscale flows on rough surfaces on Earth.

Author

Corner Flow; Microgravity; Fluid Management; Performance Prediction

20030005549 Colorado Univ., Lab. for Atmospheric and Space Physics, Boulder, CO USA

Microgravity Impact Experiments: Results from Collide-2

Colwell, Joshua E., Colorado Univ., USA; Esposito, Larry W., Colorado Univ., USA; Horanyi, Mihaly, Colorado Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 128-142; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Protoplanetary disks, planetary rings, the Kuiper belt, and the asteroid belt are collisionally evolved systems. Although objects in each system may be bombarded by impactors at high interplanetary velocities (km/s or higher), they are also subject to repeated collisions at low velocities (v approx. 1-100 m/s). In some regions of Saturn's rings, for example, the typical collision velocity inferred from observations by the Voyager spacecraft and dynamical modeling is a fraction of a centimeter per second. These interparticle collisions control the rate of energy dissipation in planetary rings and the rate of accretion in the early stages of planetesimal formation. Dust on the surface of planetary ring particles and small (1 cm - 10 m) planetesimals helps dissipate energy in the collision, but may also be knocked off, forming dust rings in the case of ring particles and slowing or inhibiting accretion in the case of planetesimals. The Collisions Into Dust Experiment (COLLIDE) is a self-contained autonomous microgravity experiment that made its second flight in the payload bay of space shuttle Endeavour on flight STS-108 in December 2001. COLLIDE-2 performed 6 impact experiments into powder in microgravity at speeds between 1.2 and 108 cm/s, simulating the collisions that occur in some astrophysical systems. Impactors were quartz spheres approximately 1.9 cm in diameter. The target material was quartz sand sieved to a size range of 75-250 microns in 5 of the 6 experiments and JSC-1, a ground basaltic mineral sieved to the same size range in the sixth experiment. The experiment took place in an evacuated standard space shuttle

Hitchhiker container fourteen hours after launch. The temperature of the samples at the time of the experiment was 17 C. Digital video recordings of the impacts were made using two consumer-grade camcorders, each one recording three impacts in sequence. Analysis of the video data provides an accurate measure of the impactor velocity before and after impact, velocity of the fastest ejecta produced (if any), and a qualitative measure of the amount of ejecta produced. On the first flight of COLLIDE on STS-90 in 1998 experiment malfunctions prevented data from being returned for 3 of the 6 impact experiments. Those experiments used JSC-1 as a target material for all impacts, and included the sub-75 micron portion of the size distribution. Impacts at 15 cm/s and 17 cm/s resulted in virtually no ejecta, and rebound coefficients of restitution were less than 0.03. A similar coefficient of restitution was found for a third impact at 90 cm/s. The broad size-distribution JSC-1 used in COLLIDE compacted during launch vibrations resulting in a cohesive surface and little or no ejecta production. The quartz sand used in COLLIDE-2 has rounder grains which do not interlock with each other as much as the semi-angular JSC-1 grains. On COLLIDE-2 we found significant ejecta produced at impact speeds above 20 cm/s and no rebound of the impactor at impact speeds below that level. The impact into JSC-1 on COLLIDE-2 was at a speed comparable to two impacts on COLLIDE, but with an impactor that was 9 times more massive. On COLLIDE-2 the impactor remained embedded in the target surface, in contrast to the slow rebound observed on COLLIDE. This difference in behavior is likely due to the absence of small particles in the COLLIDE-2 target, increasing the overall porosity of the target and allowing the surface to deform more in response to the collision. Additional information is included in the original extended abstract.

Author

Microgravity; Impact Tests; Spaceborne Experiments; Spheres; Powder (Particles); Impact Velocity

20030005559 Search for Extraterrestrial Intelligence Inst., Mountain View, CA USA

Impermanence of Static Charges on Granular Materials: Implications for Microgravity Experiments

Marshall, John, Search for Extraterrestrial Intelligence Inst., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 193-194; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The Space Station experiment 'Electrostatics of Granular Materials' (EGM), will attempt to provide unequivocal proof of the dipoles while quantifying their properties. As part of EGM development, laboratory investigations were conducted on the tribocharging of various candidate flight samples. The goal of the tests was to determine the extent of net charging in granular populations as an indicator of the charge levels that would need to be measured on Space Station. It was also important to determine if tribocharging could be achieved with a 'conservation of charge' within a given tribocharging apparatus. This conservation idea derives from a modeled concept in which positive charges are created on one surface as a result of transferring electrons to an adjacent surface: charge exchange should theoretically generate an equal number of positive and negative charges so that the system as a whole remains neutral (dipoles would be present, even with net neutrality of the grain population). The laboratory device used for tribological experiments consisted of a cylindrical glass vessel with an air jet impinging upon particles within the vessel. Particulate material was caused to continually circulate while the impelling air escaped through a diffuser/screen system. Typical circulation/collision speeds of grains were mm/sec to several m/s. Electrostatic charge in the system was determined from a hand-held electrometer (ACL Model 300B) positioned approx. 2 cm from the vessel's outer wall at 90 degrees orthogonally from the air jet. The electrometer was designed for detecting patch charges on surfaces in clean rooms. The analog readout is calibrated for fixed distances from surfaces, and it is assumed that the meter was reading the electrical field emanating from a surface charge that has a magnitude equal to the reading, presumably with respect to ground. The charge registered near the vessel includes contributions from both vessel walls and grains inside the vessel. If the system had a charge balance --i.e. the grain charging was equal and opposite to that of the vessel, the measured charge would sum to zero. This was not the case --large net charges were observed, but the cause is undetermined. Positive charge could have leaked through the vessel support structure, via leakage to air, or in some cases, via transport on comminution fines vented from the system. Quartz, glass, and plastic grains have been tested. These are candidate materials for EGM, although for convenience, larger grain sizes than those planned for EGM (approx. 300 microns) were used in the lab tests. All samples being agitated by the air resulted in negative charge readings where the electrometer was located near the base of the vessel, with the grains charging positive in some cases, negative in others (as measured by inserting the electrometer into the vessel). With all materials, and all grain sizes (ranging from several hundred microns to several millimeters), the electrometer registered several thoUSAnd volts (negative) in its external position. Glass spheres of 4 mm diameter generated in excess of - 8 kV for example. More important than the actual magnitude of this charging was the fact that the charge very rapidly dissipated as soon as the agitating air jet was turned off (this must have included discharge of the grains). Within seconds or minutes, the charge level would drop an order of magnitude to a few tens or hundreds of volts, particularly for the silicate materials. The appearance of a continuous high charge level during grain agitation and its subsequent almost immediate dissipation is attributed to grains acquiring very high voltage pulses of charge developed at grain contact points, but these charge patches are probably at or above the Gaussian limit locally, and rapidly decay by leakage or corona discharge

to air, by discharge to other grains with opposite charge patches, by surface conductivity resulting from the high voltages, and by removal of charges attached to comminution particles carried away in the air stream. Thus, charge patches on one collision spot are degenerating as fast as they are being made by another collision. With so many grains creating tens of thousands of collisions per second, the dynamic equilibrium set up by the system gives the appearance of a stable charge. Thus, the charge ordinarily measured by electrometry on static piles of granular material is probably but a fraction of the charge produced during the active tribological event. The implications of these results are twofold. First, it means that electrostatic forces in dynamic granular systems are probably orders of magnitude higher than in static systems. Dust storms on planetary surfaces, volcanic eruption plumes, and mobilized industrial powders will be highly affected by charging and this may be manifest as rapid aggregation or enhanced Coulombic friction in the granular flow. Secondly, the discovery of charge behavior in relation to tribological action adds a new and very significant enhancement to EGM science. Since charge decay can be very rapid with rates being highly material-dependent, charge cannot be regarded as a constant, and it is obviously a variable warranting investigation. We have added some new procedures to EGM --with very little additional effort, we will be able to shed light on the 'non-static' nature of static electricity. Additional information is included in the original extended abstract.

Author

Static Electricity; Tribology; Electrostatic Charge; Granular Materials; Microgravity

20030005573 Rhode Island Univ., Dept. of Mechanical Engineering, Kingston, RI USA

Melting Processes for Unfixed Phase Change Material in the Presence of Electromagnetic Field: Simulation of Low Gravity Environment

Goncalves, Eduardo, Rhode Island Univ., USA; Faghri, Mohammad, Rhode Island Univ., USA; Asako, Yutaka, Tokyo Metropolitan Univ., Japan; Charmchi, Majid, Massachusetts Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 281-282; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Electromagnetic simulation of low-gravity environment has been numerically investigated to study the transport phenomena associated with melting of an electrically conducting Phase Change Material (PCM) inside a rectangular enclosure. Electromagnetic fields are configured in such a way that the resulting Lorentz force can be used to damp and/or counteract the natural convection as well as the flow induced by sedimentation and/or floatation, and thereby simulating the low gravity environment of outer space. Computational experiments are conducted for unfixed (top-wall heated) gallium. The governing equations are discretized using a control-volume-based finite difference scheme. Numerical solutions are obtained for true low-gravity environment as well as for the simulated-low-gravity. The result shows that when the Lorentz force is caused by the presence of magnetic field alone, the low-gravity condition is simulated by the damping effect, which is shown to have a profound effect on the flow field. On the other hand, it is shown that under electromagnetic field simulation, where the Lorentz force is caused by the transverse electric and magnetic fields, it is possible to minimize the flow field distortion caused by the high magnetic field and therefore achieving a much better simulation of low-gravity. As seen here, low-gravity simulated by the electromagnetic field (or electric low-gravity), show good agreement with those of actual low gravity whereas the magnetically simulated cases, show some discrepancies. Among these discrepancies are the fact that the melt rate under some ranges magnetic low-gravity (i.e., $g(\text{sub } \beta)$ is greater than or equal to $g(\text{sub } 0)10(\text{exp } -3)$) are higher than those of electric low-gravity. This suggests that these higher melt rate cannot be attributed to the effects of Joule heating, which would otherwise favor the electric field simulation, therefore the damping effect must be the cause. Also, the 'no transient regions' on the solid velocities, suggests that the solid velocity under magnetic low-gravity respond directly to the magnetic forces, which respond much faster than the momentum diffusion associated with the melting evolution. Additional information can be found in the original extended abstract.

Author

Melting; Phase Change Materials; Electromagnetic Fields; Fluid Dynamics; Microgravity; Damping; Space Environment Simulation; Fluid Flow

COMMUNICATIONS AND RADAR

Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also 04 Aircraft Communications and Navigation; and 17 Space Communications, Spacecraft Communications, Command and Tracking; for search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation and Safety.

20030004851 SRI International Corp., Menlo Park, CA USA

Improved Open-Microphone Speech Recognition *Final Report, 28 Jun. - 15 Dec. 2002*

Abrash, Victor, SRI International Corp., USA; Dec. 23, 2002; 12p; In English

Contract(s)/Grant(s): NAG2-1568; SRI Proj. P12046; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Many current and future NASA missions make extreme demands on mission personnel both in terms of work load and in performing under difficult environmental conditions. In situations where hands are impeded or needed for other tasks, eyes are busy attending to the environment, or tasks are sufficiently complex that ease of use of the interface becomes critical, spoken natural language dialog systems offer unique input and output modalities that can improve efficiency and safety. They also offer new capabilities that would not otherwise be available. For example, many NASA applications require astronauts to use computers in micro-gravity or while wearing space suits. Under these circumstances, command and control systems that allow users to issue commands or enter data in hands-and eyes-busy situations become critical. Speech recognition technology designed for current commercial applications limits the performance of the open-ended state-of-the-art dialog systems being developed at NASA. For example, today's recognition systems typically listen to user input only during short segments of the dialog, and user input outside of these short time windows is lost. Mistakes detecting the start and end times of user utterances can lead to mistakes in the recognition output, and the dialog system as a whole has no way to recover from this, or any other, recognition error. Systems also often require the user to signal when that user is going to speak, which is impractical in a hands-free environment, or only allow a system-initiated dialog requiring the user to speak immediately following a system prompt. In this project, SRI has developed software to enable speech recognition in a hands-free, open-microphone environment, eliminating the need for a push-to-talk button or other signaling mechanism. The software continuously captures a user's speech and makes it available to one or more recognizers. by constantly monitoring and storing the audio stream, it provides the spoken dialog manager extra flexibility to recognize the signal with no audio gaps between recognition requests, as well as to rerecognize portions of the signal, or to rerecognize speech with different grammars, acoustic models, recognizers, start times, and so on. SRI expects that this new open-mic functionality will enable NASA to develop better error-correction mechanisms for spoken dialog systems, and may also enable new interaction strategies.

Author

Speech Recognition; Microphones; Product Development; Applications Programs (Computers); Acoustic Properties; Audio Signals; Signal Processing

20030005507 Naval Postgraduate School, Monterey, CA USA

Summary of Research 2000. Interdisciplinary Academic Groups

Jan. 2000; 152p; In English

Report No.(s): AD-A408378; NPS-09-02-013; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report contains project summaries of the research projects in the Interdisciplinary Academic Groups: Command, Control, Communications, Computers and Intelligence; Information Systems; Information Warfare; Modeling, Virtual Environments and Simulation; Space Systems; Special Operations; and Undersea Warfare. A list of recent publications is also included, which consists of conference presentations and publications, books, contributions to books, published journal papers, and technical reports. Thesis abstracts of students advised of an interdisciplinary nature are also included.

DTIC

Command and Control; Information Systems; Military Operations; Virtual Reality

20030005732 Pennsylvania State Univ., Applied Research Lab., University Park, PA USA

JFACC - AC2C Experiment Plan and Definition *Final Report, Aug. 1999-Feb. 2001*

Phoha, Shashi; Jul. 2002; 70p; In English; Original contains color images

Contract(s)/Grant(s): F30602-99-1-0547; AF Proj. J111

Report No.(s): AD-A408554; AFRL-IF-RS-TR-2002-162; No Copyright; Avail: Defense Technical Information Center (DTIC)

This research documents a theory that models Command and Control (C2) as control systems. This work designed, implemented and tested algorithms in the continuous domain to search for and attack targets, and to find and escort damaged friendly aircraft back to base. The research resulted in tools for building and testing controllers, and a test-bed for measuring the

performance of control systems performing C2 under simulated battlefield conditions. Experiments were planned around the design and evaluation of discrete event control hierarchies of one, two and three layers. Within each set, experiments measured the performance as a function of the experimental variables in the battlefield simulator. The results provide evidence that C2 policies can be implemented as control systems and that hierarchical control systems can shield commanders from information overload.

DTIC

Command and Control; Algorithms; Control

20030005813 Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

Electromagnetic Scattering From a Gap in a Magneto-Dielectric Coating on an Infinite Ground Plane

Simpson, George R.; Oct. 2002; 191p; In English

Report No.(s): AD-A408233; AFIT/DS/ENG/02-03; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The electromagnetic scattering from a gap in a magneto-dielectric coating on an infinite ground plane is analyzed. In this context, the gap forms a break only in the magneto-dielectric slab coating while the ground plane is continuous and unbroken. Volume equivalence is used to convert the gap region to one containing unknown volumetric equivalent electric and magnetic currents. The equivalent problem then is one of these currents radiating in the presence of an unbroken grounded magneto-dielectric slab. A Green's function for this geometry is developed consisting of two terms: a direct coupling term and correction term to account for the multiple reflected wave series resulting from the grounded-slab geometry. This bounce correction term is formulated using periodic array theory and is derived using the Array Scanning Method. A set of coupled integral equations based on these equivalent currents is then solved via the Method of Moments using pulse basis and delta testing functions. The model can represent a gap that is of a general 2D shape (the gap is assumed to be infinite in its translational direction) and can be filled with an inhomogeneous material possessing isotropic magnetic and dielectric constitutive properties different from those of the slab coating. Scattering from the gap is evaluated for plane wave illumination that is either TM or TE with respect to the gap.

DTIC

Electromagnetic Scattering; Magnetic Fields; Coating; Dielectric Properties

20030005938 Air Force Research Lab., Sensors Directorate, Hanscom AFB, MA USA

Statistical Analysis of the Nonhomogeneity Detector for Stap Applications

Rangaswamy, Muralidhar; Michels, James; Himed, Braham; Nov. 2001; 36p; In English

Contract(s)/Grant(s): AF Proj. 4619

Report No.(s): AD-A408373; AFRL-SN-HS-TR-2002-011; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We present a statistical analysis of the recently proposed non-homogeneity detector (NHD) for Gaussian interference statistics. We show that a formal goodness-of-fitness test can be constructed by accounting for the statistics of the generalized inner product (GIP) used as the NHD test statistic. Specifically, the Normalized-GIP is shown to follow a central-F distribution and admits a canonical representation in terms of two statistically independent Chi-squared distributed random variables. Moments of the GIP can be readily calculated as a result. These facts are used to derive the goodness-of-fit tests, which facilitate intelligent training data selection. Additionally, we address the issue of space-time adaptive processing (STAP) algorithm performance using the NHD as a pre-processing step for training data selection. Performance results for the adaptive matched filter (AMF) method are reported using simulated as well as measured data.

DTIC

Algorithms; Detectors; Radar Targets; Statistical Analysis

20030006094 Pittsburgh Univ., Dept. of Information Science, Pittsburgh, PA USA

Information Assurance in Wireless Networks

Kabara, Joseph; Krishnamurthy, Prashant; Tipper, David; Sep. 04, 2001; 5p; In English; Original contains color images

Contract(s)/Grant(s): F30602-97-1-0257

Report No.(s): AD-A408305; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Emerging wireless networks will contain a hybrid infrastructure based on fixed, mobile and ad hoc topologies and technologies. In such a dynamic architecture, we define information assurance as the provisions for both information security and information availability. The implications of this definition are that the wireless network architecture must (a) provide sufficient security measures, (b) be survivable under node or link attack or failure and (c) be designed such that sufficient capacity remains for all critical services (and preferably most other services) in the event of attack or component failure. We have begun a research

project to investigate the provision of information assurance for wireless networks viz. survivability, security and availability and here discuss the issues and challenges therein.

DTIC

Communication Networks; Security; Component Reliability

20030006255 Nebraska Univ., Dept. of Electrical Engineering, Lincoln, NE USA

Random Noise Monopulse Radar System for Covert Tracking of Targets

Narayanan, Ram M.; Jul. 29, 2002; 10p; In English; Original contains color images; See Also ADM201460. Papers from Unclassified Proceedings from the 11th Annual AAIA/MDA Technology Conference held in Monterey, CA from 29 Jul - 2 Aug 2002., The original document contains color images

Report No.(s): AD-A408254; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The University of Nebraska is currently developing a unique monopulse radar concept based on the use of random noise signal for covert tracking applications. This project is funded by the Missile Defense Agency (MDA). The advantage of this system over conventional frequency-modulated continuous wave (FMCW) or short pulse systems is its covertness resulting from the random waveform's immunity from interception and jamming. The system integrates a novel heterodyne correlation receiver with conventional monopulse architecture. Based on the previous work such as random noise interferometry, a series of theoretical analysis and simulations were conducted to examine the potential performance of this monopulse system. Furthermore, a prototype system is under development to exploit practical design aspects of phase comparison angle measurement. It is revealed that random noise monopulse radar can provide the same function as traditional monopulse radar, i.e., implement range and angular estimation and tracking in real time. The bandwidth of random noise signal can be optimized to achieve the best range resolution as well as the angular accuracy.

DTIC

Monopulse Radar; Frequency Modulation; Random Noise; Continuous Radiation

20030006275 Titan Systems, Inc., San Leandro, CA USA

Ultra-Wideband Antenna Development Final Report, 15 Sep. 2001-30 Sep 2002

Riordan, John C.; Sep. 2002; 35p; In English

Contract(s)/Grant(s): F49620-01-C-0047

Report No.(s): AD-A408499; 2119-JR; AFRL-SR-AR-TR-02-0385; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report summarizes the results of a 1-year effort to investigate electromagnetic dispersion caused by finite electrical conductivity in ultra-wideband antennas. Integral equations are well-suited for antenna calculations, but numerical solutions of dispersive time-domain integral equations are extremely limited. The primary cause of this situation is the computational complexity, which increases by a factor or order $N(\text{sub } t)$ (the number of time steps) for dispersive materials. We propose an efficient solution based upon surface impedance boundary conditions and upon a recursive evaluation of the time convolution integral that has a complexity increase on the order of $\log(N(\text{sub } t))$. The numerical implementation of the efficient solution for a 2-dimensional planar transmission line is described in detail. Comparison of the efficient solution with the analytic solution of the same problem show good agreement in both time and frequency domains.

DTIC

Radar Antennas; Broadband

20030006291 Draper (Charles Stark) Lab., Inc., Cambridge, MA USA

Closed-Loop Hierarchical Control of Military Air Operations Final Report

Deutsch, Owen; Adams, Milton B.; Lepanto, Janet; Jul. 2002; 174p; In English; Original contains color images

Contract(s)/Grant(s): F30602-99-C-0206; AF Proj. J117

Report No.(s): AD-A408470; AFRL-IF-RS-TR-2002-161; No Copyright; Avail: Defense Technical Information Center (DTIC)

Real-time, closed-loop optimization and control of enterprise-scale dynamic systems remains a challenging problem. Draper's approach combines the theories of decomposition of large-scale optimization problems and distributed control. The structure of the decomposed solution to the optimization problem forms a basis for our controller architecture. In contrast to ad hoc approaches to decomposing large-scale problems, our approach: (a) results in a distributed system in which situation assessment, problem solving and decision-making across C2 nodes collectively address enterprise-wide objectives; (b) provides

significant insight into the nature of the feedback required to close the loop” around each C2 node in the decomposed problem; and (c) defines the interactions among the C2 nodes to solve the enterprise-wide problem.

DTIC

Feedback Control; Command and Control

20030006662 Communications Research Lab., Japan

Airborne Multiparameter Precipitation Radar (CAMPR) Observation of Wind Fields in Snow Clouds

Satoh, Shinsuke, Communications Research Lab., Japan; Hanado, Hiroshi, Communications Research Lab., Japan; Nakagawa, Katsuhiro, Communications Research Lab., Japan; Iguchi, Toshio, Communications Research Lab., Japan; Nakamura, Kenji, Communications Research Lab., Japan; Yoshizaki, Masanori, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 53-62; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

The CRL airborne multiparameter precipitation radar (CAMPR-D) is equipped with a dual-beam antenna to measure three-dimensional wind fields in precipitation. This paper describes the methods and related problems of wind-vector calculation, and shows the results of dual-Doppler analysis. The observation data was obtained through the WMO-01 (Winter MCSs Observations over the Japan Sea 2001), the objective of which was to reveal the structure of snow clouds over the Japan Sea. First, the trajectories of the front- and rear-antenna beam were investigated. The results showed that there were some gaps between the two beam footprints due to the speed and direction of the wind relative to the aircraft, and that the front beam did not overlap the rear beam in some regions on the leeward side. The investigation also demonstrated that the data from a flight-information system (POS) consisting of an optical-fiber gyroscope and a differential GPS is effective in removing the aircraft velocity component from the measured Doppler velocity. Finally, some distributions of the wind vectors in the along-track vertical sections are shown. The wind vectors were analyzed using the observation data for linear clouds in the JPCZ (Japan Sea Polar-airmass Convergence Zone). The distributions showed that updrafts were dominant over the sea because of developing convective cells, and that the repetition of updrafts and downdrafts seemed to indicate roll convections. The distributions also showed a common structure of anvil echoes that extended northward or northeastward.

Author

Meteorological Radar; Airborne Radar; Wind (Meteorology); Clouds (Meteorology)

20030006664 Communications Research Lab., Japan

Development of Airborne High-Resolution Multi-Parameter Imaging Radar SAR, Pi-SAR

Toshihiko, Umehara, Communications Research Lab., Japan; Uratsuka, Seiho, Communications Research Lab., Japan; Kobayashi, Tatsuharu, Communications Research Lab., Japan; Satake, Makoto, Communications Research Lab., Japan; Nadai, Akitsugu, Communications Research Lab., Japan; Maeno, Hideo, Communications Research Lab., Japan; Masuko, Harunobu, Communications Research Lab., Japan; Shimada, Masanobu, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 97-112; In Japanese; Copyright; Avail: Issuing Activity

The airborne X/L-band Synthetic Aperture Radar system (Polarimetric and Interferometric SAR, Pi-SAR) was developed by the Communications Research Laboratory and National Space Development Agency of Japan in their joint project from 1993 to 1996. The resolution of the X-band image is about 1.5m and L-band is about 3.0m. Both SARs can make fully polarimetric observations. The X-band SAR has a cross-track interferometric function that measures the ground height with accuracy of 2m. These systems are installed in the airplane, Gulfstream R. In this paper we describe our Pi-SAR system and the ground processing system. In addition, we also discuss the performance of our system by using the Pi-SAR data.

Author

Airborne Radar; Imaging Radar; Synthetic Aperture Radar

20030006665 Communications Research Lab., Japan

Flight Experiments of Airborne High-Resolution Multi-Parameter Imaging Radar, Pi-SAR

Satake, Makoto, Communications Research Lab., Japan; Uratsuka, Seiho, Communications Research Lab., Japan; Umehara, Toshihiko, Communications Research Lab., Japan; Maeno, Hideo, Communications Research Lab., Japan; Nadai, Akitsugu, Communications Research Lab., Japan; Kobayashi, Tatsuharu, Communications Research Lab., Japan; Matsuoka, Takeshi, Communications Research Lab., Japan; Manabe, Takeshi, Communications Research Lab., Japan; Masuko, Harunobu, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 113-125; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

The Polarimetric and Interferometric Synthetic Aperture Radar (Pi-SAR) is an airborne high-resolution imaging radar system, having developed and being operated by Communications Research Laboratory (CRL) and National Space Development Agency of Japan (NASDA). It consists of an X-band synthetic aperture radar and L-band one, both of those are fully polarimetric and the X-band one has two receiving antennas located in crosstrack direction for interferometric observation. It has been operated for research purposes since 1996, to produce high-resolution polarimetric radar images all over Japan. In this paper we summarize results of Pi-SAR observation experiments, as well as its purposes and future plans.

Author

Airborne Radar; Imaging Radar; High Resolution; Polarimetry; Interferometry

20030006672 Communications Research Lab., Japan

Development of Long-Range Ocean Radar System

Sato, Kenji, Communications Research Lab., Japan; Matsuoka, Takeshi, Communications Research Lab., Japan; Fujii, Satoshi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 221-227; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

Communications Research Laboratory developed a new high-frequency ocean surface radar system named Long-Range Ocean Radar (LROR) that is composed of two radars located on two of the Ryukyu Islands in the southwest part of Japan. LROR is designed to observe surface currents up to 200 km from the radar sites with range resolution of 7 km and will be used for the experimental observation of upper region of the Kuroshio Current in the southern part of the East China Sea. We started performance evaluations and experimental observations in July, 2001.

Author

High Frequencies; Radar; Ocean Currents

20030006737 Communications Research Lab., Japan

Development of a 400 MHz-band Wind Profiler Radar with RASS

Adachi, Tatsuhiro, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 189-193; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

Okinawa Subtropical Environment Remote-Sensing Center of the Communications Research Laboratory has developed a new 400 MHz-band Wind Profiler Radar (400M-WPR) since FY 1997 in a research and development project of remote-sensors for measuring subtropical environment. After construction of the Ogimi Wind Profiler Facility at Ogimi village in Okinawa, the 400M-WPR has continued wind velocity profiling with an altitude range from approximately 400 m to typically 13 km, and with an interval of a few minutes. We were successful for the wind profiling up to 16 km near the center of a typhoon Nari approached in September 2001. Besides, a RASS attached to the 400M-WPR could obtain virtual temperature profiles p to about 3 km.

Author

Meteorological Radar; Wind Measurement; Remote Sensors

20030006738 Communications Research Lab., Japan

Development of the CRL Okinawa Bistatic Polarimetric Radar

Nakagawa, Katsuhiro, Communications Research Lab., Japan; Hanado, Hiroshi, Communications Research Lab., Japan; Satoh, Shinsuke, Communications Research Lab., Japan; Iguchi, Toshio, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 203-209; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

Communications Research Laboratory (CRL) has developed a new C-band multi-parameter Doppler radar system with a bistatic Doppler network to establish a next-generation technology of rain observation for meteorological and hydrological applications such as weather forecasts and run-off analysis in predicting floods. This new radar is named COBRA (CRL Okinawa Bistatic polarimetric Radar). COBRA has polarization, monostatic Doppler, and bistatic Doppler observation functions. The targets of this system are typhoons, Baiufrontal rainfall, meso-scale precipitation in subtropical zones, and clear air turbulence. to measure the polarization characteristics of rainfall, the main radar can select one of six kinds of polarizations for every transmitting pulse, and then both the horizontal and vertical polarizations are measured simultaneously by two receiver systems.

Author

Doppler Radar; Microwave Frequencies; Meteorological Radar; Weather Forecasting; Multistatic Radar; Polarimetry

ELECTRONICS AND ELECTRICAL ENGINEERING

Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment and microelectronics and integrated circuitry. For related information see also 60 Computer Operations and Hardware; and 76 Solid-State Physics. For communications equipment and devices see 32 Communications and Radar.

20030004735 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

On Polymorphic Circuits and Their Design Using Evolutionary Algorithms

Stoica, Adrian, Jet Propulsion Lab., California Inst. of Tech., USA; Zebulum, Ricardo, Jet Propulsion Lab., California Inst. of Tech., USA; Keymeulen, Didier, Jet Propulsion Lab., California Inst. of Tech., USA; Lohn, Jason, NASA Ames Research Center, USA; [2002]; 6p; In English; 20th IASTED International Conference on Applied Informatics, Unknown; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper introduces the concept of polymorphic electronics (polytronics) - referring to electronics with superimposed built-in functionality. A function change does not require switches/reconfiguration as in traditional approaches. Instead the change comes from modifications in the characteristics of devices involved in the circuit, in response to controls such as temperature, power supply voltage (VDD), control signals, light, etc. The paper illustrates polytronic circuits in which the control is done by temperature, morphing signals, and VDD respectively. Polytronic circuits are obtained by evolutionary design/evolvable hardware techniques. These techniques are ideal for the polytronics design, a new area that lacks design guidelines, know-how, - yet the requirements/objectives are easy to specify and test. The circuits are evolved/synthesized in two different modes. The first mode explores an unstructured space, in which transistors can be interconnected freely in any arrangement (in simulations only). The second mode uses a Field Programmable Transistor Array (FPTA) model, and the circuit topology is sought as a mapping onto a programmable architecture (these experiments are performed both in simulations and on FPTA chips). The experiments demonstrated the synthesis of polytronic circuits by evolution. The capacity of storing/hiding "extra" functions provides for watermark/invisible functionality, thus polytronics may find uses in intelligence/security applications.

Author

Electric Potential; Transistors; Chips; Simulation

20030005518 California Univ., Dept. of Computer Engineering, Santa Barbara, CA USA

Current Apertured Vertical Electron Transistor (CAVET) Final Report, 1 Jan.-31 Dec. 2001

Mishra, Umesh K.; Dec. 2001; 14p; In English

Report No.(s): AD-A408527; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We have demonstrated the first GaN current aperture vertical electron transistor (CAVET). A 2 micrometer thick GaN:Si drain region followed by a 0.4 micrometer GaN:Fe insulating layer and an 800 Angstrom unintentionally doped GaN cap were grown by MOCVD on a c-plane sapphire substrate. Channel apertures were etched, and a maskless regrowth was performed to grow conducting GaN inside the channel as well as to thicken the UID GaN above the insulating layer and add an AlGaIn cap layer. C12 RIE was used to pattern the device mesa. Source, drain, and gate pads were then deposited. Devices with aperture widths ranging from 0.4 micrometer to 2 micrometer have been demonstrated. DC transistor characteristics were measured, and the effects of varying the aperture length and the gate overlap were investigated. Electrical characteristics of a device with a 0.6 micrometer aperture and a gate overlap of 2 micrometer are illustrated in Fig 2. This device had a source-drain saturation current of 430 mA/mm and an extrinsic transconductance of 100 mS/mm. Additionally, conditions for PEC etching of an InGaIn layer for the CAVET illustrated in Fig 1d have been optimized.

DTIC

Transistors; Transconductance; Electrical Properties

20030005877 State Univ. of New York, Office of Research and Sponsored Programs, Binghamton, NY USA

Analysis and Characterization of an Acousto-Optic Beam Position Control System Final Report, May 2000-May 2001

Skorman, Victor; Jul. 2002; 119p; In English; Original contains color images

Contract(s)/Grant(s): F30602-00-1-0582; AF Proj. 558B

Report No.(s): AD-A408361; AFRL-IF-RS-TR-2002-158; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This is the final report for study of laser beam position control using an Acousto-Optic cell. The effort was performed under a Cooperative Research and Development Agreement (CRDA) between the State of New York University in Binghamton and the Air Force Research Laboratory. The study consisted of five parts: Theoretical analysis, experimental analysis of the system

components, cell design considerations, comparison with the behavior of a system based on Piezo-Electric technology, and finally the design and performance of a model reference adaptive control system for using the cell in a jitter rejection mode.

DTIC

Acousto-Optics; Adaptive Control; Laser Beams; Beam Steering

20030005933 Silicon Integration Initiative, Inc., Austin, TX USA

Electronic Design Automation (EDA) Roadmap Taskforce Report, Design of Microprocessors Final Report, 14 Sep. 1993-30 Apr. 1999

Apr. 1999; 185p; In English; Original contains color images

Contract(s)/Grant(s): F33615-930C01314; AF Proj. A268

Report No.(s): AD-A408348; AFRL-IF-WP-TR-2002-1529; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The goal of this project was to support the establishment of tool interoperability standards for the semiconductor industry. Accomplishments include the publication of the 'EDA Industry Standards Roadmap - 1996' and the 'EDA Roadmap Taskforce Report - Design of Microprocessors.'

DTIC

Electronics; Microprocessors; Semiconductor Devices; Design

20030006322 California Univ., Electrical Engineering Dept., Los Angeles, CA USA

Microwave-Optical Novel Detection Devices Final Report, 1 May 1998 30 Apr. 2002

Poberezhskiy, I.; Fetterman, H. R.; Chang, D. H.; Apr. 30, 2002; 8p; In English

Contract(s)/Grant(s): F49620-98-1-0446; AF Proj. 3484

Report No.(s): AD-A408285; AFRL-SR-AR-TR-02-330; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Frequency conversion of optical waves as a result of refraction through a (moving interface in traveling wave electrooptic phase modulators is analyzed. Two configurations of a device performing conversion are proposed, and their operating requirements are determined. There are several approaches to frequency conversion in optical WDM systems.

DTIC

Optics; Electro-Optics; Optical Measurement; Detection; Microwaves

20030006326 Massachusetts Inst. of Tech., Cambridge, MA USA

Dynamics of Triangular and Square Arrays Final Report, Feb. 1996-Feb 1997

Orlando, Terry P.; Sep. 2002; 11p; In English; Original contains color images

Contract(s)/Grant(s): F30602-96-1-0059; Proj-2304

Report No.(s): AD-A408275; AFRL-SN-RS-TR-2002-255; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The DC characteristics of single triangular Josephson Junction (JJ) cells and single row arrays have been studied to their potential as rf oscillators. Measurements of under damped systems reveal two steps in the current voltage (IV) characteristic, corresponding to LSC and LJ resonances. These steps are characteristics of single cells, and their position does not change significantly with array size. Measurements of two different cell sizes showed that the upper step voltage depends strongly on the cell geometry, while the lower step is only slightly affected. At the LSC resonance, underdamped arrays produce large amplitude single harmonic oscillations in the horizontal junctions. According to DC measurements oscillators based on this resonance operate at frequencies ranging from 70 - 170 GHz, with bandwidths of 10% - 20%. For 9mm² junctions, the power expected from M horizontal junctions is M²nW for low current densities and M²InW for high current densities. to study the possibility of mode locking in a 2D triangular array, simple diamond cells have been investigated. In addition to a common bias current, a small trim current applied to the bottom triangle of a diamond will engender an rf voltage at two frequencies corresponding to the upper and lower cell oscillations. The DC properties of the diamond system have been confirmed, and on chip measurements of the system are planned to confirm the response of the horizontal junction to trim current tuning.

DTIC

Arrays; Josephson Junctions; Resonant Frequencies; Radio Frequencies; Bandwidth; Electric Potential

20030006660 Communications Research Lab., Japan

Development of Superconducting Submillimeter-Wave Limb-Emission Sounder (JEM/SMILES) Aboard the International Space Station

Manabe, Takeshi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 9-19; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

In recent years, stratospheric ozone depletion is one of the most significant global environmental issues. It is well known that stratospheric trace gases, which include chlorine oxides and bromine oxides, play a crucial role in the process of stratospheric ozone destruction. Although the abundances of these trace gases are as low as in the order of parts per billion or less, they are quite efficient to destroy stratospheric ozone by catalytic reactions. In order to establish the techniques to monitor stratospheric ozone and ozone-depleting molecules, CRL (Communications Research Laboratory) and NASDA are collaborating to develop Superconducting Submillimeter-Limb Emission Sounder (JEM/SMILES) to be aboard the Japanese Experiment Module (JEM) of the International Space Station. In this paper, the outline of the JEM/SMILES project and the payload instrument is introduced.

Author

Atmospheric Composition; Stratosphere; Spacecraft Instruments; Sounding; Ozone Depletion; Ozonometry; Submillimeter Waves

20030006675 Pacific Northwest National Lab., Richland, WA USA

Technology Demonstration of Magnetically-Coupled Adjustable Speed Drive Systems

Chvala, W. D.; Winiarski, D. W.; Mulkerin, M. C.; Jun. 2002; 80p; In English

Report No.(s): DE2002-15001096; PNNL-13879; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Most large electric motors run at a nearly constant speed, although the devices they drive particularly pumps, fans, or blowers are often used to meet loads that vary over time. Adjustable speed drive (ASD) technologies have the ability to precisely control output speed and produce a number of benefits including energy and demand savings. This report deals with a specific class of ASDs called magnetically-coupled adjustable speed drives (MC-ASDs) and examines their performance and cost effectiveness with a more common ASD device, the electronic variable frequency drive (VFD).

NTIS

Speed Control; Mechanical Drives; Pumps

34

FLUID MECHANICS AND THERMODYNAMICS

Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also 02 Aerodynamics.

20030004708 Institute for Computer Applications in Science and Engineering, Hampton, VA USA

The Stress-strain Behavior of Polymer-Nanotube Composites from Molecular Dynamics Simulations Final Report

Frankland, S. J. V., Institute for Computer Applications in Science and Engineering, USA; Harik, V. M., Institute for Computer Applications in Science and Engineering, USA; Odegard, G. M., Institute for Computer Applications in Science and Engineering, USA; Brenner, D. W., North Carolina State Univ., USA; Gates, T. S., NASA Langley Research Center, USA; November 2002; 19p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211953; NAS 1.26:211953; ICASE-2002-41; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright under contract NAS1-97046; Distribution as joint owner in the copyright under contract NAS1-97046

Stress-strain curves of polymer-carbon nanotube composites are derived from molecular dynamics simulations of a single-walled carbon nanotube embedded in polyethylene. A comparison is made between the response to mechanical loading of a composite with a long, continuous nanotube (replicated via periodic boundary conditions) and the response of a composite with a short, discontinuous nanotube. Both composites are mechanically loaded in the direction of and transverse to the NT axis. The long-nanotube composite shows an increase in the stiffness relative to the polymer and behaves anisotropically under the different loading conditions. The short-nanotube composite shows no enhancement relative to the polymer, most probably because of its low aspect ratio. The stress-strain curves are compared with rule-of-mixtures predictions.

Author

Carbon Nanotubes; Molecular Dynamics; Computerized Simulation; Composite Structures; Loads (Forces); Polyethylenes; Mechanical Properties

20030004744 Institute for Computer Applications in Science and Engineering, Hampton, VA USA

Self-Consistent Physical Properties of Carbon Nanotubes in Composite Materials Final Report

Pipes, R. B., Akron Univ., USA; Frankland, S. J. V., Institute for Computer Applications in Science and Engineering, USA; Hubert, P., McGill Univ., Canada; Saether, E., NASA Langley Research Center, USA; December 2002; 20p; In English

Contract(s)/Grant(s): NAS1-97046; NCC1-02002; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-212134; NAS 1.26:212134; ICASE-2002-46; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright under contract NAS1-97046; Distribution as joint owner in the copyright under contract NAS1-97046

A set of relationships is developed for selected physical properties of single-walled carbon nanotubes (SWCN) and their hexagonal arrays as a function of nanotube size in terms of the chiral vector integer pair, (n,m). Properties include density, principal Young's modulus, and specific Young's modulus. Relationships between weight fraction and volume fraction of SWCN and their arrays are developed for polymeric mixtures.

Author

Carbon Nanotubes; Modulus of Elasticity; Composite Structures; Concentration (Composition); Volume; Mathematical Models; Geometry; Chirality

20030004837 Garrett Engine Co., Phoenix, AZ USA

Transition Mixing Study Empirical Model Report Final Report

Srinivasan, R., Garrett Engine Co., USA; White, C., Garrett Engine Co., USA; February 1988; 128p; In English

Contract(s)/Grant(s): NAS3-24340

Report No.(s): NASA-CR-182139; NAS 1.26:182139; Garrett-21-6689; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The empirical model developed in the NASA Dilution Jet Mixing Program has been extended to include the curvature effects of transition liners. This extension is based on the results of 3-D numerical model results generated under this contract. The empirical model results agree well with the numerical model results for all the test cases evaluated. The empirical model shows faster mixing rates compared to the numerical model. Both models show drift of jets toward the inner wall of a turning duct. The structure of the jets from the inner wall does not exhibit the familiar kidney-shaped structures observed for the outer wall jets or for jets injected in rectangular ducts.

Author

Three Dimensional Models; Fluid Jets; Jet Mixing Flow

20030004839 Garrett Turbine Engine Co., Phoenix, AZ USA

Dilution Jet Mixing Program Phase III Report Final Report

Srinivasan, R., Garrett Turbine Engine Co., USA; Myers, G., Garrett Turbine Engine Co., USA; Coleman, E., Garrett Turbine Engine Co., USA; White, C., Garrett Turbine Engine Co., USA; June 1985; 138p; In English

Contract(s)/Grant(s): NAS3-22110

Report No.(s): NASA-CR-174884; NAS 1.26:174884; Garrett-21-5418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The main objectives of the NASA Dilution Jet Mixing Phase III Program were as follows: 1) Extend the data base on the mixing of single-sided rows of jets in a confined cross flow to discrete slots, including streamlined, bluff, and angled injections; 2) Quantify the effects of geometrical and flow parameters on penetration and mixing of multiple rows of jets into a confined cross flow. Investigate in-line, staggered, and dissimilar hole configurations; 3) Determine the effects of unequal flow rates through the axially staged jets; and 4) Develop empirical correlations for predicting temperature distributions for discrete slots and multiple rows of dilution holes.

Author

Temperature Distribution; Jet Mixing Flow; Flow Characteristics; Confinement; Flow Velocity; Fluid Jets

20030004841 Garrett Turbine Engine Co., Phoenix, AZ USA

Dilution Jet Mixing Program Supplementary Report Final Report

Srinivasan, R., Garrett Turbine Engine Co., USA; White, C., Garrett Turbine Engine Co., USA; March 1986; 236p; In English

Contract(s)/Grant(s): NAS3-22110; RTOP 533-04-12

Report No.(s): NASA-CR-175043; NAS 1.26:175043; Garrett-21-5705; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This report presents a comparison of the velocity and temperature distributions predicted by a 3-D numerical model and experimental measurements. In addition, empirical correlations for the jet velocity trajectory developed in this program are

presented. The measured velocity distributions for all test cases of Phase I through Phase III in this program (Contract NAS3-22110) are presented in the form of contour and oblique plots.

Author

Temperature Distribution; Velocity Distribution; Three Dimensional Models; Jet Mixing Flow; Fluid Jets

20030004843 NASA Ames Research Center, Moffett Field, CA USA

Computation of Transonic Flows Using Potential Methods

Hoist, Terry L., NASA Ames Research Center, USA; [1997]; 1p; In English; No Copyright; Avail: Issuing Activity

The proposed paper will describe the state of the art associated with numerical solution of the full or exact velocity potential equation for solving transonic, external-aerodynamic flows. The presentation will begin with a review of the literature emphasizing research activities of the past decade. Next, the various forms of the full or exact velocity potential equation, the equation's corresponding mathematical characteristics, and the derivation assumptions will be presented and described in detail. Impact of the derivation assumptions on simulation accuracy, especially with respect to shock wave capture, will be presented and discussed relative to the more complete Euler or Navier-Stokes formulations. The technical presentation will continue with a description of recently developed full potential numerical approach characteristics. This description will include governing equation nondimensionalization, physical-to-computational-domain mapping procedures, a limited description of grid generation requirements, the spatial discretization scheme, numerical implementation of boundary conditions, and the iteration scheme. The next portion of the presentation will present and discuss numerical results for several two- and three-dimensional aerodynamic applications. Included in the results section will be a discussion and demonstration of a typical grid refinement analysis for determining spatial convergence of the numerical solution and level of solution accuracy. Computer timings for a variety of full potential applications will be compared and contrasted with similar results for the Euler equation formulation. Finally, the presentation will end with concluding remarks and recommendations for future work.

Author

Transonic Flow; Navier-Stokes Equation; Computational Grids; Differential Equations; Boundary Conditions

20030005097 Aerojet Liquid Rocket Co., Sacramento, CA USA

Multiple Jet Study Data Correlation Final Report

Walker, R. E., Aerojet Liquid Rocket Co., USA; Eberhardt, R. G., Aerojet Liquid Rocket Co., USA; April 1975; 77p; In English
Contract(s)/Grant(s): NAS3-18026

Report No.(s): NASA-CR-134795; NAS 1.26:134795; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Correlations are presented which allow determination of penetration and mixing of multiple cold air jets injected normal to a ducted subsonic heated primary air stream. Correlations were obtained over jet-to-primary stream momentum flux ratios of 6 to 60 for locations from 1 to 30 jet diameters downstream of the injection plane. Injection orifice diameters used in the correlations ranged from 0.64 cm to 2.54 cm and orifice spacing/diameter ratios from 2 to 6 were used. The range of geometric and operating variables makes the correlations relevant to gas turbine combustors. Correlations were obtained for the mixing efficiency between jets and primary stream using an energy exchange parameter developed on NAS3-15703. In addition, jet centerplane velocity and temperature trajectories were correlated and centerplane dimensionless temperature distributions defined. An assumption of a Gaussian vertical temperature distribution at all stations was shown to result in a reasonable temperature field model. Data is presented which allows comparison of predicted and measured values over the range of conditions specified above.

Author

Air Flow; Air Jets; Gas Streams; Penetration; Subsonic Flow

20030005108 Aerojet Liquid Rocket Co., Sacramento, CA USA

Multiple Jet Study Final Report, 31 Mar. 1972 - 31 Mar. 1973

Walker, R. E., Aerojet Liquid Rocket Co., USA; Kors, D. L., Aerojet Liquid Rocket Co., USA; June 1973; 111p; In English
Contract(s)/Grant(s): NAS3-15703

Report No.(s): NASA-CR-121217; NAS 1.26:121217; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Test data is presented which allows determination of jet penetration and mixing of multiple cold air jets into a ducted subsonic heated mainstream flow. Jet-to-mainstream momentum flux ratios ranged from 6 to 60. Temperature profile data is presented at various duct locations up to 24 orifice diameters downstream of the plane of jet injection. Except for two configurations, all geometries investigated had a single row of constant diameter orifices located transverse to the main flow direction. Orifice size and spacing between orifices were varied. Both of these were found to have a significant effect on jet penetration and mixing. The best mixing of the hot and cold streams was achieved with spacing between the orifices equal to one half of the duct height. For this spacing, variation in orifice size changed the mean exit temperature level, but did not significantly alter the shape of the

distributions. The mixing at the various test conditions was evaluated using an energy exchange parameter developed in this program. Comparison of the results of this study with existing single jet data indicates that single jet correlations do not adequately describe the multiple jet results.

Author

Jet Mixing Flow; Cross Flow; Combustion; Subsonic Flow; Injection

20030005291 Case Western Reserve Univ., Dept. of Mechanical and Aerospace Engineering, Cleveland, OH USA

Dilution Jet Configurations in a Reverse Flow Combustor *Final Report*

Zizelman, James, Case Western Reserve Univ., USA; April 1985; 214p; In English

Contract(s)/Grant(s): NSG-3206; RTOP 535-05-12

Report No.(s): NASA-CR-174888; NAS 1.26:174888; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

Results of measurements of both temperature and velocity fields within a reverse flow combustor are presented. Flow within the combustor is acted upon by perpendicularly injected cooling jets introduced at three different locations along the inner and outer walls of the combustor. Each experiment is typified by a group of parameters: density ratio, momentum ratio, spacing ratio, and confinement parameter. Measurements of both temperature and velocity are presented in terms of normalized profiles at azimuthal positions through the turn section of the combustion chamber. Jet trajectories defined by minimum temperature and maximum velocity give a qualitative indication of the location of the jet within the cross flow. Results of a model from a previous temperature study are presented in some of the plots of data from this work. During injection from all three injection locations (inner wall prior to the turn, outer wall prior to the turn, and outer wall into the turn) a migration of the injected fluid toward the inner wall is observed both from temperature and velocity fields. Penetration into the cross flow is shown to be affected as follows: increasing injection jet momentum increases penetration, increasing the ratio of the jet density to the cross flow density increases penetration, and increasing spacing between jets in multiple jet injection increases penetration. Lateral spreading seemed to be greater during higher momentum injection and during injection from the outer wall. The above conclusions appear consistent with the flow field that sets up in the combustor. The flow is observed as inertially dominated and characteristically irrotational as a pressure gradient develops to support fluid turning.

Author

Combustion Chambers; Reversed Flow; Velocity Distribution; Temperature Distribution

20030005478 NASA Glenn Research Center, Cleveland, OH USA

The NASA Microgravity Fluid Physics Program: Knowledge for Use on Earth and Future Space Missions

Kohl, Fred J., NASA Glenn Research Center, USA; Singh, Bhim S., NASA Glenn Research Center, USA; Alexander, J. Iwan, National Center for Microgravity Research on Fluids and Combustion, USA; Shaw, Nancy J., NASA Glenn Research Center, USA; Hill, Myron E., NASA Glenn Research Center, USA; Gati, Frank G., NASA Glenn Research Center, USA; December 2002; 19p; In English; 53rd International Astronautical Congress, 10-19 Oct. 2002, Houston, TX, USA; Sponsored by International Astronautical Federation, Unknown; Original contains color illustrations

Contract(s)/Grant(s): RTOP 400-35-80-01

Report No.(s): NASA/TM-2002-212009; NAS 1.15:212009; E-13698; IAC-02-T.4.02; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Building on over four decades of research and technology development related to the behavior of fluids in low gravity environments, the current NASA Microgravity Fluid Physics Program continues the quest for knowledge to further understand and design better fluids systems for use on earth and in space. The purpose of the Fluid Physics Program is to support the goals of NASA's Biological and Physical Research Enterprise which seeks to exploit the space environment to conduct research and to develop commercial opportunities, while building the vital knowledge base needed to enable efficient and effective systems for protecting and sustaining humans during extended space flights. There are currently five major research areas in the Microgravity Fluid Physics Program: complex fluids, multiphase flows and phase change, interfacial phenomena, biofluid mechanics, and dynamics and instabilities. Numerous investigations into these areas are being conducted in both ground-based laboratories and facilities and in the flight experiments program. Most of the future NASA-sponsored fluid physics and transport phenomena studies will be carried out on the International Space Station in the Fluids Integrated Rack, in the Microgravity Science Glovebox, in EXPRESS racks, and in other facilities provided by international partners. This paper will present an overview of the near- and long-term visions for NASA's Microgravity Fluid Physics Research Program and brief descriptions of hardware systems planned to achieve this research.

Author

Fluid Dynamics; Space Missions; Aerospace Environments; Microgravity; Multiphase Flow

20030005485 NASA Langley Research Center, Hampton, VA USA

Adaptive Identification and Control of Flow-Induced Cavity Oscillations

Kegerise, M. A., NASA Langley Research Center, USA; Cattafesta, L. N., Florida Univ., USA; Ha, C., Florida Univ., USA; [2002]; 7p; In English; 1st AIAA Flow Control Conference, 24-27 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-3158; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Progress towards an adaptive self-tuning regulator (STR) for the cavity tone problem is discussed in this paper. Adaptive system identification algorithms were applied to an experimental cavity-flow tested as a prerequisite to control. In addition, a simple digital controller and a piezoelectric bimorph actuator were used to demonstrate multiple tone suppression. The control tests at Mach numbers of 0.275, 0.40, and 0.60 indicated approx. = 7dB tone reductions at multiple frequencies. Several different adaptive system identification algorithms were applied at a single freestream Mach number of 0.275. Adaptive finite-impulse response (FIR) filters of orders up to $N = 100$ were found to be unsuitable for modeling the cavity flow dynamics. Adaptive infinite-impulse response (IIR) filters of comparable order better captured the system dynamics. Two recursive algorithms, the least-mean square (LMS) and the recursive-least square (RLS), were utilized to update the adaptive filter coefficients. Given the sample-time requirements imposed by the cavity flow dynamics, the computational simplicity of the least mean squares (LMS) algorithm is advantageous for real-time control.

Author

Adaptive Control; Fluid Dynamics; Cavity Flow; Oscillations; Real Time Operation; Mean Square Values

20030005526 NASA Glenn Research Center, Cleveland, OH USA

Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6, Volume 2

Singh, Bhim, Compiler, NASA Glenn Research Center, USA; November 2002; 640p; In English; Abstracts and Presentations of a Conference, 14-16 Aug. 2002, Cleveland, OH, USA; Sponsored by NASA Glenn Research Center, USA; Also announced as 20030005527 through 20030005615; Original contains color illustrations

Contract(s)/Grant(s): RTOP 101-43-0B

Report No.(s): NASA/CP-2002-211212/VOL2; E-13064-1/VOL2; NAS 1.55:211212/VOL2; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

The Sixth Microgravity Fluid Physics and Transport Phenomena Conference provides the scientific community the opportunity to view the current scope of the Microgravity Fluid Physics and Transport Phenomena Program, current research opportunities, and plans for the near future. The conference focuses not only on fundamental research but also on applications of this knowledge towards enabling future space exploration missions. A whole session dedicated to biological fluid physics shows increased emphasis that the program has placed on interdisciplinary research. The conference includes invited plenary talks, technical paper presentations, poster presentations, and exhibits. This CP (conference proceeding) is a compilation of the abstracts, presentations, and posters presented at the conference.

Author

Fluid Dynamics; Microgravity; Heat Transfer; Fluid Flow; Transport Properties; Conferences; Phase Transformations

20030005528 Cornell Univ., School of Chemical Engineering, Ithaca, NY USA

Prediction of Particle Clustering in Turbulent Aerosols

Chun, Jaehun, Cornell Univ., USA; Ahluwalia, Aruj, Pennsylvania State Univ., USA; Koch, Donald L., Cornell Univ., USA; Collins, Lance R., Cornell Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 3; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

It has long been recognized that heavy particles in the micron size range embedded in a turbulent flow field are thrown out of regions of high vorticity and collect in regions of high strain. This particle clustering has a profound effect on processes such as collision, coalescence and evaporation/condensation. For example, recent work in the meteorology community suggests this effect may play an important role in the evolution of droplet nuclei in cumulus clouds. A recent study by Reade & Collins (2000) showed that the tendency of particles to cluster continues down to length scales much smaller than the Kolmogorov scale. Indeed, the particle pair correlation function was shown to increase as a power law of the inverse of the particle pair separation distance indefinitely (or at least until the finite particle size cuts it off). The traditional explanation of particle clustering based on the

'centrifuge' effect cannot explain this sub-Kolmogorov scale clustering. Motivated by this observation, we have developed an analytical theory for the pair correlation function for particles with a small but finite Stokes number.

Author

Aerosols; Turbulent Flow; Flow Distribution; Particle Theory; Pair Production

20030005530 NASA Glenn Research Center, Cleveland, OH USA

PCS: The First Fluid Physics Payload on ISS

Doherty, M., NASA Glenn Research Center, USA; Sankaran, S., National Center for Microgravity Research on Fluids and Combustion, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 5-7; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The Physics of Colloids in Space (PCS) experiment was accommodated within International Space Station (ISS) EXPedite the PRocessing of Experiments to Space Station (EXPRESS) Rack 2 and was remotely operated from early June 2001 until February 2002 from NASA Glenn Research Center's Telescience Support Center in Cleveland, Ohio and from a remote site at Harvard University in Cambridge, Massachusetts. PCS is an experiment conceived by Professor David A. Weitz of Harvard University (the Principal Investigator), focusing on the behavior of three different classes of colloid mixtures. The sophisticated light scattering instrumentation comprising PCS is capable of color imaging, and dynamic and static light scattering from 11 to 169 degrees, Bragg scattering over the range from 10 to 60 degrees, and laser light scattering at low angles from 0.3 to 6.0 degrees. The PCS instrumentation performed remarkably well, demonstrating a flexibility that enabled experiments to be performed that had not been envisioned prior to launch. While on-orbit, PCS accomplished 2400 hours of science operations, and was declared a resounding success. Each of the eight sample cells worked well and produced interesting and important results. Crystal nucleation and growth and the resulting structures of two binary colloidal crystal alloys were studied, with the long duration microgravity environment of the ISS facilitating extended studies on the growth and coarsening characteristics of the crystals. In another experiment run, the de-mixing of the colloid-polymer critical-point sample was studied as it phase-separates into two phases, one that resembles a gas and one that resembles a liquid. This process was studied over four decades of length scale, from 1 micron to 1 centimeter, behavior that cannot be observed in this sample on Earth because sedimentation would cause the colloids to fall to the bottom of the cell faster than the de-mixing process could occur. Similarly, the study of gelation and aging of another colloid-polymer sample, the colloid-polymer gel, also provided valuable information on gelation mechanisms, as did investigations on the extremely low concentration silica and polystyrene fractal gel samples.

Author

Colloids; International Space Station; Payloads; Spaceborne Experiments; Polymers; Fluid Dynamics

20030005533 Kansas State Univ., Dept. of Physics, Manhattan, KS USA

Kinetics and Percolation in Dense Particulate Systems

Sorensen, Chris, Kansas State Univ., USA; Chakrabarti, Amit, Kansas State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 11; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Our work involves both experimentation and simulation of aggregating particle systems that form fractal aggregates that eventually fill space to form gels. Our experimental system is soot in diffusion flames. Our simulations model these flames as 3d, off lattice, Brownian motion systems, also known as diffusion limited cluster aggregation (DLCA). We observe in these systems the behavior of the kinetics, cluster size distribution, and cluster morphology as the system evolves from dilute to concentrated and finally to the gel. With simulations, we find that the dynamical evolution of the system obeys typical DLCA type kinetics at early times when the system is dilute with a constant kinetic exponent $z=1$ and size distribution exponent $\lambda=0$. With increasing aggregation time crowding of clusters occurs and the kinetics can be described by continuously evolving exponents. Both exponents show universal behavior with aggregate volume fraction, independent of the initial volume fraction. Remarkably, the relationship between z and λ maintains its mean-field nature i.e., mean field kinetics continue to hold when the system is crowded. Small angle light scattering from heavily sooting flames shows submicron D approximately equal to 1.8 fractal aggregates early in the flame but later, as the soot growth continues, a new supermicron phase appears with a fractal dimension of ca. 2.7. Simulations show essentially the same behavior and allow us to determine that these superaggregates occur when the smaller, D approximately equal to 1.8 DLCA aggregates percolate. With this, we propose the following picture of the sol-to-gel transition: A dilute sol aggregates via DLCA or RLCA kinetics yielding aggregates with fractal dimensions of D approximately equal to 1.8 or 2.15, respectively. Because these aggregate fractal dimensions are less than the spatial dimension, the effective aggregate volume fraction (the occupied volume of the aggregates normalized by the system volume) approaches unity as the aggregation proceeds. Structure factor results for the largest cluster and the entire system imply that the fractal dimension of the

aggregates remains 1.8 (or 2.15 for RLCA) right up to the ideal gel point. At the ideal gel point, the aggregates are so crowded that they percolate to form a D approximately equal to 2.6 superaggregate made up of D approximately equal to 1.8 (or 2.15 for RLCA) aggregates with an average size of $R(\text{sub } g)G$, the ideal gel point radius of gyration.

Author

Aggregates; Kinetics; Particulates; Percolation; Simulation; Diffusion Flames

20030005536 Yale Univ., Dept. of Chemical Engineering, New Haven, CT USA

The Effect of Flow on Drop Coalescence

Nemer, Martin, Yale Univ., USA; Chen, Xiaohui, Yale Univ., USA; Blawdziewicz, Jerzy, Yale Univ., USA; Loewenberg, Michael, Yale Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 26-36; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Drop coalescence is a complex process due to the nonlinear dynamics of a system with deformable interfaces. In earlier studies the effect of an external flow on near-contact motion of drops was assumed to be equivalent to an external body force. Accordingly, the direct coupling between thin-film flow (in the near-contact region) and flow inside the drops was neglected. These assumptions have been used in calculations of collisional efficiencies and analyses of experimental results. Our investigations show that for drops with tangentially mobile interfaces the above assumptions do not hold. The velocity field produced inside the drops by the external flow couples to the film motion through tangential stress $f(\infty)$ acting on the film interface. For sufficiently thin films (e.g., long times), this stress qualitatively alters the dynamics of the lubrication region by arresting or enhancing film drainage.

Author

Coalescing; Drops (Liquids); Mathematical Models; Fluid Flow; Flow Distribution

20030005537 New Hampshire Univ., Dept. of Chemical Engineering, Durham, NH USA

Dynamics of Surfactant-Laden Drops in a Hele-Shaw Cell

Gupta, Nivedita R., New Hampshire Univ., USA; Nadim, Ali, Claremont Graduate School, USA; Haj-Hariri, Hossein, Virginia Univ., USA; Borhan, Ali, Pennsylvania State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 37-47; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Buoyancy-driven motion of a liquid drop in a Hele-Shaw cell filled with a second immiscible liquid is considered. In the absence of surfactants, a circle is an exact solution to the depth-averaged Hele-Shaw equations. A circular drop is shown to be linearly stable to infinitesimal shape perturbations provided the interfacial tension is finite. The evolution of the shape of a translating drop subject to finite initial shape deformations is studied by using the boundary integral method to solve the Hele-Shaw equations. Drops that are initially elongated in the direction of motion are found to revert to a circular shape for all Bond numbers considered. The stability of the shape of drops that are initially flattened (elongated normal to the direction of motion) depends on the extent of their initial deformation and the Bond number. Experimental observations of transient drop shapes show good qualitative agreement with the numerical predictions for both symmetric and asymmetric initial shape perturbations. In the presence of adsorbed surfactants, the interface separating the drop from the continuous liquid phase possesses its own distinct rheological properties. As the drop moves, the adsorbed surfactants are constantly redistributed along the interface by advection and diffusion, and give rise to nonuniformities in interfacial tension along the interface. This, in turn, affects the movement of the drop and its shape evolution. Dynamics of translating drops in the presence of bulk-insoluble surfactants are examined using the Langmuir adsorption framework in conjunction with a slip layer model derived for the depth-averaged tangential stress exerted on the two-phase interface. Given the initial shape of the drop and the buoyancy force acting on it, the interfacial distributions of velocity and surfactant concentration are computed, and the evolution of the drop shape is followed in time in order to identify the effect of interface contamination on the critical conditions for drop breakup.

Author

Drops (Liquids); Interfacial Tension; Liquid-Liquid Interfaces; Fluid Dynamics; Surface Stability; Buoyancy-Driven Flow; Deformation

20030005538 Colorado Univ., Dept. of Chemical Engineering, Boulder, CO USA

Surface Collisions Involving Particles and Moisture (SCIP'M)

Davis, Robert H., Colorado Univ., USA; Rager, Dean A., Colorado Univ., USA; Good, Brian T., Colorado Univ., USA; Kantak, Advait, Colorado Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 48-62; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Collisions of particles with wet surfaces are important in filtration, agglomeration, wet granular flow, and pollen capture. Laboratory experiments involve dropping small plastic and metal balls onto a surface overlaid with a thin layer of a viscous fluid. Critical conditions for bouncing instead of sticking are determined with the aid of high-frequency stroboscopic photography. For bouncing, the rebound velocity, angle, and rotation are determined by image analysis. Bouncing increases with increasing ball size and impact speed, and with decreasing viscosity and thickness of the fluid layer. The results are interpreted using elastohydrodynamic theory, accounting for lubrication pressure in the thin viscous layer and elastic deformation of the solid ball and opposing surface. The laboratory experiments are restricted to high impact velocities (approximately 1 m/s, or higher), as otherwise gravitational acceleration obscures the rebound. As a result, relatively thick and viscous fluids layers on the surface are required to observe the transition between bouncing and sticking. Future experiments with lower impact speeds (approximately 0.1 m/s, or lower) and surfaces wetted with water are planned for a low-gravity environment.

Author

Particle Collisions; Solid Surfaces; Surface Properties; Elastohydrodynamics; Elastic Deformation; Kinetic Energy; Image Analysis; Dimensionless Numbers; Viscosity

20030005539 Bremen Univ., Center of Applied Space Technology and Microgravity, Germany

Critical Velocities in Open Capillary Flows

Ohlhoff, Antje, Bremen Univ., Germany; Rosendahl, Uwe, Bremen Univ., Germany; Dreyer, Michael E., Bremen Univ., Germany; Rath, Hans J., Bremen Univ., Germany; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 63-74; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

We consider a forced liquid flow in an open capillary channel with free liquid surfaces under low gravity. The channel consists of two parallel plates and is shown in Figure 1. The liquid flows along the x-axis from the inlet to the outlet and forms free surface at the sides between the plates. The flow is maintained by external pumps and the free surface deforms according to the pressure along the flow path. Since the free surface can only withstand a certain difference between the liquid pressure and the ambient pressure the flow rate in the channel is limited. The aim of the consideration is also to determine the shape of the free surface and to find the maximum flow rate without a collapse of the free surface. This critical flow rate depends on the geometry of the channel and the properties of the liquid, specified by the three dimensionless parameters, the Ohnesorge number $Oh = (\rho \nu / \sigma)^{1/2}$, the aspect ratio $\lambda = b/\alpha$ and the dimensionless length ι (ρ is the density, ν is the kinematic viscosity and σ the surface tension of the fluid). The right picture in Fig. 1 shows the cross section area α perpendicular to the flow direction. $\kappa(x) = z(\chi, y = 0)$ is the observed and computed innermost line of the free surface, $Q^*(\text{sub crit}) = Q(\text{sub crit})/\alpha$ the critical volume flux.

Author

Capillary Flow; Fluid Dynamics; Critical Flow; Critical Velocity; Viscosity; Interfacial Tension; Microgravity; Liquid Surfaces

20030005540 Texas A&M Univ., Dept. of Mechanical Engineering, College Station, TX USA

Microscale Investigation of Thermo-Fluid Transport In the Transition Film Region of an Evaporating Capillary Meniscus Using a Microgravity Environment

Kihm, K. D., Texas A&M Univ., USA; Allen, J. S., National Center for Microgravity Research on Fluids and Combustion, USA; Hallinan, K. P., Dayton Univ., USA; Pratt, D. M., Wright Lab., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 75-76; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

In low gravity, the solid-liquid inter-molecular surface forces are comparable to capillary and gravitational forces at significantly greater film thickness (1 approximately 10 microns), than is possible in earth's gravity (0.01 approximately 0.1 microns). Therefore, advanced microscale optical techniques to measure the film thickness, heat transport, and liquid velocity fields in the transition film region of an extended meniscus; probing, for the first the thermo-fluid transport inside this very important micro-scale region. Since the project initiation in the beginning of 2002, a preliminary ground study has been done to implement a Molecular Fluorescence Tracking Velocimetry (MFTV) system, utilizing caged fluorophores of approximately 10 nm in size as seeding particles, ultimately to measure the velocity profiles in the thin film region. Fizeau interferometry in

conjunction with a microscope has been completed to measure the thin film slope and thickness variations. Although the extension of the thin film dimensions under microgravity will be achieved by using a conical evaporator, a simpler and easy-to-fabricate evaporator has been designed and constructed for the ground test. Note that the experimental setup is to maintain a constant liquid volume and liquid pressure in the capillary region of the evaporating meniscus so as to insure quasi-stationary conditions during measurements on the transition film region. In addition, the new Confocal Laser Scanning Microscopy (CLSM), available at Dr. Kihm's laboratory, has been tested for its optical sectioning capability allowing a depth-wise resolution for MFTV applications. A micro-heater array has been fabricated using photo-lithography to etch and vapor deposit platinum films. The heater array is packaged on a thin silicon substrate and then the upper face of the substrate is planarized to form a smooth contact surface. Individual heater elements (20-micron-wide and 20-mm long) are designed to maintain either a constant surface temperature or a controlled temperature variation. A Wheatstone bridge circuit controls each heater element with the temperature-dependent heater resistance value as a feedback signal.

Author

Fluid Dynamics; Microgravity; Menisci; Liquid-Solid Interfaces; Intermolecular Forces; Fluid Flow; Transport Properties

20030005543 National Center for Microgravity Research on Fluids and Combustion, Cleveland, OH USA

Optical Measurement of Mass and Thermal Diffusion Fluids

Rashidnia, Nasser, National Center for Microgravity Research on Fluids and Combustion, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 99-106; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A robust instrument is developed to measure much needed crucial thermophysical properties such as diffusion coefficient of miscible fluids, concentration and thermal gradient fields with high precision.

Author

Optical Measurement; Interferometers; Diffusion Coefficient; Fluid Dynamics; Thermal Diffusion; Viscosity; Liquid-Vapor Interfaces; Fluid Flow

20030005544 Orbital Technologies Corp., USA

Magnetic Fluid Management (MFM)

Rice, Eric, Orbital Technologies Corp., USA; Gustafson, Robert, Orbital Technologies Corp., USA; Hochstein, John, Orbital Technologies Corp., USA; Marchetta, Jeff, Orbital Technologies Corp., USA; Chiaverini, Martin, Orbital Technologies Corp., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 107-108; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The difficult problem of cryogenic fluid handling in many aerospace applications in low gravity environments can be solved by employing a new magnetic fluid technology called magnetic fluid management (MFM). The innovative MFM technology has the potential to provide significant advancements over other technologies such as screens, vanes, porous plugs, and no-vent fill processes. MFM technology utilizes the magnetic properties of cryogenic fluids for phase separation. This enables new processes which greatly simplify many critical tasks now encountered, such as gas-free liquid transfer between cryogenic containers, liquid-free gas venting during storage, liquid-free gas venting during tank refill, and use of a self-regulating control system to maintain tank pressure during liquid expulsion.

Author

Fluid Management; Magnetic Properties; Microgravity; Cryogenic Fluids; Cryogenic Fluid Storage; Computational Fluid Dynamics; Computerized Simulation; Fluid Flow

20030005545 Clarkson Univ., Dept. of Chemical Engineering, Potsdam, NY USA

Motion of Drops on Surfaces with Wettability Gradients

Subramanian, R. Shankar, Clarkson Univ., USA; McLaughlin, John B., Clarkson Univ., USA; Moumen, Nadjoua, Clarkson Univ., USA; Qian, Dongying, Clarkson Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 109-121; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

A liquid drop present on a solid surface can move because of a gradient in wettability along the surface, as manifested by a gradient in the contact angle. The contact angle at a given point on the contact line between a solid and a liquid in a gaseous medium is the angle between the tangent planes to the liquid and the solid surfaces at that point and is measured within the liquid side, by convention. The motion of the drop occurs in the direction of increasing wettability. The cause of the motion is the net force exerted on the drop by the solid surface because of the variation of the contact angle around the periphery. This force causes acceleration

of an initially stationary drop, and leads to its motion in the direction of decreasing contact angle. The nature of the motion is determined by the balance between the motivating force and the resisting hydrodynamic force from the solid surface and the surrounding gaseous medium. A wettability gradient can be chemically induced as shown by Chaudhury and Whitesides who provided unambiguous experimental evidence that drops can move in such gradients. The phenomenon can be important in heat transfer applications in low gravity, such as when condensation occurs on a surface. Daniel et al have demonstrated that the velocity of a drop on a surface due to a wettability gradient in the presence of condensation can be more than two orders of magnitude larger than that observed in the absence of condensation. In the present research program, we have begun to study the motion of a drop in a wettability gradient systematically using a model system. Our initial efforts will be restricted to a system in which no condensation occurs. The experiments are performed as follows. First, a rectangular strip of approximate dimensions 10 x 20 mm is cut out of a silicon wafer. The strip is cleaned thoroughly and its surface is exposed to the vapor from an alkylchlorosilane for a period lasting between one and two minutes inside a desiccator. This is done using an approximate line source of the vapor in the form of a string soaked in the alkylchlorosilane. Ordinarily, many fluids, including water, wet the surface of silicon quite well. This means that the contact angle is small. But the silanized surface resists wetting, with contact angles that are as large as 100 degs. Therefore, a gradient of wettability is formed on the silicon surface. The region near the string is highly hydrophobic, and the contact angle decreases gradually toward a small value at the hydrophilic end away from this region. The change in wettability occurs over a distance of several mm. The strip is placed on a platform within a Plexiglas cell. Drops of a suitable liquid are introduced on top of the strip near the hydrophobic end. An optical system attached to a video camera is trained on the drop so that images of the moving drop can be captured on videotape for subsequent analysis. We have performed preliminary experiments with water as well as ethylene glycol drops. Results from these experiments will be presented in the poster. Future plans include the refinement of the experimental system so as to permit images to be recorded from the side as well as the top, and the conduct of a systematic study in which the drop size is varied over a good range. Experiments will be conducted with different fluids so as to obtain the largest possible range of suitably defined Reynolds and Capillary numbers. Also, an effort will be initiated on theoretical modeling of this motion. The challenges in the development of the theoretical description lie in the proper analysis of the region in the vicinity of the contact line, as well as in the free boundary nature of the problem. It is known that continuum models assuming the no slip condition all the way to the contact line fail by predicting that the stress on the solid surface becomes singular as the contact line is approached. One approach for dealing with this issue has been to relax the no-slip boundary condition using the Navier model. Molecular dynamics simulations of the contact line region show that for a non-polar liquid on a solid surface, the no-slip boundary condition is in fact incorrect near the contact line. Furthermore, the same simulations also show that the usual relationship between stress and the rate of deformation breaks down in the vicinity of the contact line. In developing continuum theoretical models of the system, we shall accommodate this knowledge to the extent possible.

Author

Drops (Liquids); Solid Surfaces; Surface Properties; Kinematics; Wettability; Liquid-Solid Interfaces; Fluid Dynamics; Scaling Laws

20030005548 Pittsburgh Univ., Dept. of Physics and Astronomy, Pittsburgh, PA USA

Two-Dimensional Turbulence in the Presence of a Polymer

Jun, Yonggun, Pittsburgh Univ., USA; Wu, X. L., Pittsburgh Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 125-126; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Polymers of sufficient length are known to quench turbulence. However, the fundamental mechanism of quenching, namely the interactions between the polymer and turbulence, is not well understood. In this experiment, we examine the effect of a polymer additive to turbulence in a freely suspended film. The experimental geometry is two-dimensional due to the fact that films are very thin, confining the flow velocity to the plane of the film. The turbulence in the film is created by electromagnetic convection as delineated in the figure below. Here a uniform electric current is injected into a salt-doped film, and the ionic current in the film couples to an externally imposed magnetic field, giving rise to a set of vortices. Various convection states can be achieved depending on the magnitude of the current, but in this study we are interested in a large applied current so that flow in the film is spatiotemporally chaotic, or turbulent. The flow velocity field can be interrogated by a particle imaging velocimeter, which consists of a CCD camera and a pulsed laser. Since we are ultimately interested in studying polymer conformational fluctuations in the presence of turbulent velocity field, large lambda-DNA molecules are used in the experiment. The lambda-DNA has a contour length of 16 microns which folded into a globular form of radius approx. 1 micron in diameter. Preliminary observations show that there exist two different flow regimes depending on the DNA concentrations. For low DNA concentrations (less than 50 ppm), the 2D film is homogeneous and the turbulent velocity field is similar to those without polymers. For higher DNA concentrations, the film develops inhomogeneities when the turbulent intensity becomes large, with $v(\text{sub rms})$ is greater than 10 cm/s. Tenuous filaments spontaneously appear and are sometimes discernible to naked eyes. The thin filaments appears to be due

to aggregation of DNA molecules, since no such aggregates are present in the bulk suspension, or in the absence of strong turbulence. It remains an intriguing possibility that quenching of turbulence may be a collective effect rather than due to single polymers as suggested by different theories. Our current work concentrates on optical microscopy to visualize individual DNAs will put this question to rest. Additional information is included in the original extended abstract.

Author

Turbulence; Additives; Magnetic Fields; Vortices; Flow Velocity; Deoxyribonucleic Acid

20030005553 NASA Glenn Research Center, Cleveland, OH USA

Phase-Shifting Liquid Crystal Interferometers for Microgravity Fluid Physics

Griffin, DeVon W., NASA Glenn Research Center, USA; Marshall, Kenneth L., Rochester Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 162-164; In English; Also announced as 20030005526; Original contains color illustrations

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The initial focus of this project was to eliminate both of these problems in the Liquid Crystal Point-Diffraction Interferometer (LCPDI). Progress toward that goal will be described, along with the demonstration of a phase shifting Liquid Crystal Shearing Interferometer (LCSI) that was developed as part of this work. The latest LCPDI, other than a lens to focus the light from a test section onto a diffracting microsphere within the interferometer and a collimated laser for illumination, the pink region contained within the glass plates on the rod-mounted platform is the complete interferometer. The total width is approximately 1.5 inches with 0.25 inches on each side for bonding the electrical leads. It is 1 inch high and there are only four diffracting microspheres within the interferometer. As a result, it is very easy to align, achieving the first goal. The liquid crystal electro-optical response time is a function of layer thickness, with thinner devices switching faster due to a reduction in long-range viscoelastic forces between the LC molecules. The LCPDI has a liquid crystal layer thickness of 10 microns, which is controlled by plastic or glass microspheres embedded in epoxy 'pads' at the corners of the device. The diffracting spheres are composed of polystyrene/divinyl benzene polymer with an initial diameter of 15 microns. The spheres deform slightly when the interferometer is assembled to conform to the spacing produced by the microsphere-filled epoxy spacer pads. While the speed of this interferometer has not yet been tested, previous LCPDIs fabricated at the Laboratory for Laser Energetics switched at a rate of approximately 3.3 Hz, a factor of 10 slower than desired. We anticipate better performance when the speed of these interferometers is tested since they are approximately three times thinner. Phase shifting in these devices is a function of the AC voltage level applied to the liquid crystal. As the voltage increases, the dye in the liquid crystal tends to become more transparent, thus introducing a rather large amount of error into the phase-shifting measurement. While that error can be greatly reduced by normalization, we prefer eliminating the source of the error. To that end, we have pursued development of a 'blend' of custom dyes that will not exhibit these properties. That goal has not yet been fully achieved. Guardalben, et al, presented a similar set of interferograms in a paper partially funded by this grant. Shearing interferometers are a second class of common path interferometers. Typically they consist of a thick glass plate optimized for equal reflection from the front and back surface. While not part of the original thrust of the project, through the course of laboratory work, we demonstrated a prototype of a shearing interferometer capable of phase shifting using a commercial liquid crystal retardation plate. A schematic of this liquid crystal shearing interferometer (LCSI) and a sample set of interferograms are in the reference. This work was also supported by the U.S. Department of Energy Office of Inertial Confinement Fusion under Cooperative Agreement No. DE-FC03-92SF19460, the University of Rochester, and the New York State Energy Research and Development Authority. The support of DOE does not constitute an endorsement by DOE of the views expressed in this article. Additional information is included in the original extended abstract.

Author

Phase Shift; Liquid Crystals; Interferometers; Microgravity; Fluid Dynamics

20030005555 California Inst. of Tech., Pasadena, CA USA

Granular Materials Flows with Interstitial Fluid Effects

Hunt, M. L., California Inst. of Tech., USA; Brennen, C. E., California Inst. of Tech., USA; Campbell, C. S., University of Southern California, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 167-177; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

In 1954, R.A. Bagnold published his seminal findings on the rheological properties of liquid-solid flows. We recently completed an extensive reevaluation of Bagnold's work, and our analysis and simulations indicate that the rheological measurements of Bagnold were affected significantly by secondary flows within the experimental apparatus. The concentric cylinder rheometer was designed by Bagnold to measure simultaneously the shear and normal forces for a wide range for solid concentrations, fluid viscosities and shear rates. As presented by Bagnold, the shear and normal forces depended linearly on the

shear rate in the 'macroviscous' regime. As the grain-to-grain interactions increased in the 'grain inertia' regime, the stresses depended on the square of the shear rate and were independent of the fluid viscosity. These results, however, appear to be dictated by the design of the experimental facility. In Bagnold's experiments, the height (h) of the rheometer was relatively short compared to the spacing (t) between the rotating outer and stationary inner cylinder ($h/t=4.6$). Since the top and bottom end plates rotated with the outer cylinder, the flow contained two axisymmetric counter-rotating cells in which flow moved outward along the end plates and inward at the midheight of the annulus. These cells contribute significantly to the measured torque, and obscured any accurate measurements of the shear or normal stresses. Before doing the reevaluation of Bagnold's work, our research objective was to examine the effects of the interstitial fluid for flows in which the densities of the two phases were different. After reevaluating Bagnold's work, we redesigned our experimental facility to minimize secondary flow effects. Like Bagnold's facility, we use a concentric cylinder rheometer with a rotating outer wall. The inner cylinder also is able to rotate slightly but will also be restrained by flexible supports; the torque is measured from the deformation of the flexures. The normal force is measured using piezoelectric transducers that record both impacts with the surface and fluid pressure variations resulting from particle collisions. Unlike Bagnold's apparatus, the top and bottom plates of the annulus will not rotate, and the torque measurement will be measured only in the center region of the inner annulus; these changes will minimize the secondary flow effects. The experiments will cover a range of particle sizes (from $d = 1.5$ to 4 mm), particle concentrations (up to 55% solids concentration by volume), shear rates ($\gamma = 10$ -160/sec) and solid-to-fluid densities ($\rho_{\text{sub p}} = 1.2$ to 8). During one flight of the KC-135 we will change two parameters: the rotational speed and the fluid viscosity (μ). At one time during a flight, we plan to withdraw some of the fluid (water for example) within the annulus while injecting some fluid of a different viscosity (water-glycerin mixture). Hence, the experiments will cover flows where the particle inertia dominates the fluid effects (granular flows) to flows in which the fluid inertia dominates that of the particles (dilute suspension). The range of Stokes numbers ($St=d(\exp 2) \gamma \rho_{\text{sub p}}/\mu$) will be from about 5 to 3000. Currently, the experimental facility has just been completed. We have calibrated the normal impact measurements using carefully controlled single particle impacts with the transducers. The torque measurements have also been calibrated by mounting the inner cylinder in such a way that we could impose a known load on the drum. We use reluctance transducers to measure the motion and deformation of the flexures and calibrate the device with the imposed load. Measurements will also be made of the fluid temperature, acceleration and rotational speed of the outer drum.. Additional information is included in the original extended abstract.

Author

Rheology; Rheometers; Granular Materials; Solids Flow; Shear Stress; Interstitials

20030005557 Cornell Univ., School of Chemical Engineering, Ithaca, NY USA

Experimental Study of Turbulence-Induced Coalescence in Aerosols

Duru, Paul, Cornell Univ., USA; Wang, Luying, Cornell Univ., USA; Cohen, Claude, Cornell Univ., USA; Koch, Donald L., Cornell Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 180-181; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

An aerosol consists of a dispersion of liquid particles in a gas. Coalescence occurs when Brownian motion, differential sedimentation or turbulent gas flow drive two drops into contact and the drops form a larger drop. Coalescence modifies the size distribution of an aerosol which in turn affects its main properties. For instance, raindrop coalescence play an important role in cloud dynamics, precipitation and the scavenging of pollutants by precipitation. The rate of coalescence depends on the forces driving the relative motion of the particles. A good fundamental understanding of the mechanisms of coalescence leading to quantitative predictions of coalescence rates has been achieved for colloidal particles suspended in liquids. This achievement is largely attributable to the ability of researchers to isolate each of the driving forces in turn by judicious use of the density matching of the fluid and particles and adjustment of the fluid viscosity. In contrast, the current understanding of aerosol coalescence is rudimentary. Moreover, in experimental conditions on Earth, one is likely to observe mixed effects of Brownian motion, sedimentation and turbulence on coalescence making a critical test of theory difficult. We present an experimental ground-based study of aerosol coalescence due to turbulence. It will provide the necessary background to plan a microgravity experiment on aerosol coalescence. An initially nearly monodisperse aerosol with high particle number density (typically 10 particles/cu cm) is produced using a Condensation Monodisperse Aerosol Generator (TSI 3475). It flows continuously through a plexiglass cell where it experiences a turbulent flow field generated by an oscillating grid. The initial size distribution is then modified due to turbulence-induced coalescence. Using droplets with an initial mean diameter of 3 μ m, we maximize the importance of turbulence on coalescence relative to Brownian motion (important for smaller particles) and sedimentation (important for larger particles). to be able to compare experimental data on turbulence-induced coagulation with theory, a precise description of the turbulent flow field is necessary. It has been characterized by measuring the velocity fluctuations using a laser Doppler velocimetry technique. The turbulent kinetic energy is found to be constant in the central region of the cell (within a distance away from the grid mean

position equal to half the stroke of the grid displacement) and then to decay away from the grid. Our results are similar to that which one expects, based on previous experiments in liquids. In order to characterize the coalescence, the particle size distribution is measured in situ using a Particle Dynamics Analyzer. This technique is based on the analysis of the light scattered by the particles as they cross a volume of measurement defined by the intersection of two laser beams. The size distribution being known, the particle number density can be measured using a light attenuation technique. As already mentioned, the extent to which we can isolate turbulence from the other mechanisms that may lead to coagulation is limited and this forms the motivation for the future microgravity experiments. Under microgravity, we will be able to use substantially larger particles and eliminate Brownian motion without introducing effects of sedimentation. However, this ground-based experiment will demonstrate the validity of our experimental methods to characterize the coalescence. Additional information is contained within the original extended abstract.

Author

Aerosols; Coalescing; Turbulence

20030005558 Maryland Univ., Dept. of Physics, College Park, MD USA

Non Steady State Granular Shear Flows

Losert, Wolfgang, Maryland Univ., USA; Kwon, Gene, Maryland Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 182-192; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

We experimentally investigate the shear flow of granular matter in a cylindrical Couette cell. Since granular flows dissipate energy, they must be continuously driven to remain in a flowing state. Previous experiments on steady state shear flows have found that velocity gradients are confined to a thin shear band, and that the shear force is roughly independent of shear rate if the material is allowed to dilate. Our experiments in a Couette geometry focus on two related questions about non-steady state flows: 1) How does a granular shear flow start? 2) How does a granular system respond to oscillatory shear? In particular, we investigate the role of boundary conditions, which we expect to be of particular importance, since granular flows must be continuously driven (in general from a boundary) in order to be sustained. In our Couette cell a shear flow is generated by moving either the inner cylinder or the outer cylinder or both cylinders. The motion of grains on the top surface is measured directly with fast imaging and particle tracking techniques. Previous studies have indicated that the velocity profile on the top surface is very similar to the velocity profile within the bulk. Measurements of the corresponding shear forces are in progress. Initial experiments determined the steady state flow profiles under different driving conditions, with either inner, outer or both cylinders moving. In steady state, velocity gradients are confined to a roughly exponential shearband several particle diameters wide. The shear band is always located at the inner cylinder. A probable reason for this observation is the slightly smaller surface area of the inner cylinder compared to the outer cylinder. Since shear forces are transmitted from one cylinder to the other, the smaller surface area of the inner cylinder leads to larger shear stresses. Shear flow confined to regions of high stress can be reproduced in continuum mechanics models which include plastic flow, non-Newtonian fluid models, or locally Newtonian hydrodynamic models that include a strong density dependence of viscosity. Most of these models are isotropic with respect to the shear direction. However, anisotropies manifest themselves in two distinct flow transients, when rotation of one of the cylinders is started. When the cylinder had been rotated in the same direction before, the thin shear band immediately forms. When the previous motion of the cylinder had been in the opposite direction, particles far from the moving cylinder are initially more mobile. After an extra displacement of up to six particle diameters, a thin shearband forms again in steady state. The extra displacement of particles far from the shear surface does not strongly depend on the shear rate prior or after the stop, solely on the direction of prior shear. This indicates that the static configuration of grains after a shear flow exhibits anisotropies. The flow transient, at least, can then no longer be modeled with the isotropic form of the models described above. Finally, we investigate oscillatory shear flow. During small amplitude oscillations the shear flow is confined to a thin shear band. In addition, a gradual compaction and strengthening of the granular material is observed. For sufficiently large oscillation amplitudes, the flow resembles a sequence of shear reversals. In oscillatory flows driven by the outer cylinder, coexistence of shearbands at the outer and inner cylinder can be found. In summary, we have elucidated important properties of granular shear flows from non-steady state flow measurements: First, shear bands form preferentially near the inner cylinder, even when the outer cylinder is sheared. Transiently a shear band can also form near the outer cylinder during oscillatory driving. These observations should help refine models of granular shear flow. One challenge in improving models of granular shear flow is the observation that the initial flow transient contains 'memory' of the direction of previously applied shear. In order to incorporate this observation into flow models, the nature of the anisotropy requires further study. Currently we are investigating the three dimensional configuration of grains during the start of shear flow using confocal microscopy.

Author

Unsteady State; Granular Materials; Shear Flow; Couette Flow; Boundary Conditions; Continuum Mechanics

20030005560 Massachusetts Inst. of Tech., Dept. of Mechanical Engineering, Cambridge, MA USA

An Interferometric Investigation of Moving Contact Line Dynamic in Spreading Polymer Liquids

Kavehpour, Pirouz, Massachusetts Inst. of Tech., USA; McKinley, Gareth H., Massachusetts Inst. of Tech., USA; Ovryn, Ben, Case Western Reserve Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 195-205; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

We have developed a phase-shifted laser feedback interferometer (psLFI) that can be used to rapidly and non-invasively measure the interfacial profile in the vicinity of moving contact lines of simple Newtonian and complex fluids. The test fluids used in the present study are constant-viscosity silicone oils (Gelest Inc.) which perfectly wet the smooth silicon substrate. The viscosities are varied from 7 less than or equal to μ less than or equal to $10(\exp 4)$ cSt in order to explore a wide range of capillary numbers, $Ca = \mu U / \sigma$ (here σ is the surface tension and U is the steady spreading velocity). For wetting systems (in which the liquid spreads spontaneously to give a nominally zero contact angle) a precursor or primary film moves ahead of the main body of liquid. When the disjoining pressures are large and the viscosity small, the precursor films may spread quite rapidly for significant distances ahead of the bulk fluid. A syringe pump delivers a precise volume of liquid onto a clean silicon substrate. During the spreading process, the psLFI system is focused on the substrate in front of the moving wetting line and the spreading film flows past the approximately 1 μ m diameter spot focused by the high numerical aperture objective lens. In order to estimate the optical path length (OPL) and interference fringe visibility, the intensity of the laser is monitored in real-time and discrete phase shifts are introduced using an electro-optic modulator (EOM); this process is automated using Labview. From the OPL data we can follow the evolution of the local thickness of the drop, $h(x)$, as a function of time. The left vertical axis shows the drop profile $h(x)$ [in nm] as a function of the lateral position x [in μ m]. The right-hand axis shows the interference fringe visibility, m . The polished silicon substrate has a high visibility (m approx. 0.095) however this drops suddenly about 100 μ m before the apparent or macroscopic contact line passes the measurement point. In this offset region a very thin liquid film (approx. 100 nm) can be detected in front of the contact line. The length of this precursor film, LP , is measured from the position where the visibility drops to the position where the drop thickness starts to increase rapidly. We are currently using this technique to image the spatio-temporal evolution of the shape of the 'foot' in more complex fluids such as Xanthan gum (a rigid rod polymer), flexible polymer solutions and also highly entangled polymer melts. Additional information is included in the original extended abstract.

Author

Interferometry; Liquids; Polymers; Spreading; Newtonian Fluids

20030005561 Georgia Inst. of Tech., Atlanta, GA USA

Droplet Formation Processes in Solids-Laden Liquids

Furbank, Roy J., Georgia Inst. of Tech., USA; Morris, Jeffrey F., Georgia Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 206; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The formation of droplets is an important phenomenon in many industrial applications as well as an interesting and challenging physical problem. Many of these processes involve the formation of droplets from particle-laden liquids including ink-jet printing technology, fuel combustion, and spray drying operations. This work investigates how the presence of solid particles in a suspending liquid affects the droplet formation process. Droplet formation from pure liquids has been extensively studied both experimentally and numerically and is fairly well understood. However, little information is available concerning the process for solid-liquid suspensions. Experiments to date have investigated the formation of pendant drops of suspensions of varying particle volume fraction (ϕ) into both a second immiscible liquid and into ambient air. For each case the thread length achieved at pinch-off and the resulting drop size are measured and the effect of increasing ϕ observed. The results of these experiments which illustrate the particle effects most clearly are the qualitative characteristics of the structure developed during the necking and subsequent pinch-off of the drop. For low particle concentration (typically up to ϕ approx. 0.10) the structure observed near pinch-off is the asymmetrical 'needle-sphere' combination described by Peregrine et al for pure fluids. At larger particle fractions the structure observed near pinch-off becomes significantly different and the forming droplet has a less spherical, pear-like shape. This shape is similar to that observed by Shi et al for increasingly viscous pure fluids and can lead to pinch-off occurring in a more variable manner at a location away from the edge of the forming drop. Simple rheological arguments based on the effective viscosity increase with ϕ fail to explain these qualitative changes in the drop structure. In addition to studying the case where purely pendant drops are formed at the orifice exit, this work also seeks to understand how particles affect the process after jetting has occurred. Understanding the flow behavior in this regime is critical to any practical application involving the use of particle-laden liquids. With this aim, experiments are in progress to investigate the transition from pendant to jetting droplet formation behavior, focusing on how the presence of solid particles in the liquid affect this transition. Future work will

continue these efforts with a focus on expanding these initial experiments towards smaller scales, seeking to determine the generality of the influence of suspended particles.

Author

Drops (Liquids); Solid Suspensions; Particulates

20030005562 Pennsylvania State Univ., Dept. of Physics, University Park, PA USA

Avalanche Dynamics and Stability in Wet Granular Media

Schiffer, Peter, Pennsylvania State Univ., USA; Tegzes, Pal, Eoetvoes LORANd Univ., Hungary; Vicsek, Tamas, Eoetvoes LORANd Univ., Hungary; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 207-215; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

In our previous work, we identified three fundamental regimes for the repose angle of wet granular materials as a function of the liquid content. The granular regime at very low liquid contents is dominated by the motion of individual grains; in the correlated regime corresponding to intermediate liquid contents, a rough surface is formed by the flow of separated clumps; and the repose angle of very wet samples results from cohesive flow with viscoplastic properties. Here we report investigations of the avalanche dynamics and flow properties of wet granular materials, employing a rotating drum apparatus (a cylindrical chamber partly filled with a granular medium and rotated around a horizontal axis). At low rotation rates, the medium remains at rest relative to the drum while its surface angle is slowly increased by rotation, up to a critical angle $\theta_{\text{sub max}}$ where an avalanche occurs, thus decreasing the surface angle to the repose angle $\theta_{\text{sub r}}$. The flow becomes continuous at high rotation rates, but the transition between avalanching and continuous flow is hysteretic in rotation rate in dry media. Previous studies of cohesive granular media in a rotating drum have focused on the surface angles of the medium before and after avalanches. In our measurements, we focus instead on characterizing the dynamics of cohesive flow. We quantitatively investigate the flow dynamics during avalanches at different liquid contents by analyzing the time evolution of the averaged surface profile obtained from hundreds of avalanche events, and we also measure surface velocities during continuous flow. In particular, we explore the nature of the viscoplastic flow, (observed at the highest liquid contents) in which there are lasting contacts during flow, leading to coherence across the entire sample. This coherence leads to a velocity independent flow depth at high rotation rates and novel robust pattern formation in the granular surface. Additional information is included in the original extended abstract.

Avalanches; Granular Materials; Flow Characteristics; Cohesion; Fluid Dynamics; Flow Stability

20030005563 Pennsylvania State Univ., Dept. of Physics, University Park, PA USA

Drag Force and Penetration in Granular Media

Schiffer, Peter, Pennsylvania State Univ., USA; Tsui, Yeekin, Pennsylvania State Univ., USA; Albert, Istvan, Notre Dame Univ., USA; Barabasi, Albert-Laszlo, Notre Dame Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 216-224; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The motion of a solid object being pulled slowly through a granular medium is resisted by jamming of the grains, resulting in a drag force which differs dramatically from viscous drag in a fluid both in its average properties and in having large fluctuations with distinct characteristics. The drag process thus provides an excellent test-bed for the strength of locally jammed states among the grains and the effects of confinement on the jamming. We have studied the drag force as a function of the velocity, the depth in the medium, the grain size and morphology for a vertical cylinder. The data agree well with theory for spherical media, but show an anomalously strong depth dependence for non-spherical grains. We also study the drag force on discrete objects with circular cross section moving slowly through a spherical granular medium. Variations in the geometry of the dragged object change the drag force only by a small fraction relative to shape effects in fluid drag. The drag force depends quadratically on the object's diameter as expected. We do observe, however, a deviation above the expected linear depth dependence, and the magnitude of the deviation is apparently controlled by geometrical factors. We also have studied fluctuations in the drag force experienced by a vertical moving through a granular medium. The successive formation and collapse of jammed states give a stick-slip nature to the fluctuations which are periodic at small depths but become 'stepped' at large depths, a transition which we interpret as a consequence of the long-range nature of the force chains and the finite size of our experiment. Very recent work has focused on the effects of solid barriers within the grains on penetration of a granular medium. We have studied the force required to insert an object vertically into a granular medium, with particular attention to the effect of the bottom boundary. We find that, despite the long range nature of the force chains, the existence of the solid bottom of the granular container only affects the force when

the inserted object is within a short range of the bottom, and that the roughness of the bottom surface has a strong effect on the force's depth profile. Additional information is included in the original extended abstract.

Author

Drag; Granular Materials; Penetration; Pulling; Pushing

20030005564 Clarkson Univ., Dept. of Civil and Environmental Engineering, Potsdam, NY USA

Constitutive Relation in Transitional Granular Flows

Shen, Hayley H., Clarkson Univ., USA; Hanes, Daniel M., Florida Univ., USA; Jenkins, James T., Cornell Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 225-243; In English; Also announced as 20030005526; Original contains color illustrations

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To study the constitutive behavior of granular materials, the presence of gravity is detrimental. Although empirical relations have been obtained for engineering designs to control granular flows on Earth, it is not known how well these Earthbound relations can be used in another gravity field. Fundamental understanding must be derived to reliably design for granular flows in space exploration. There are two extremes of granular flows of which significant amount of knowledge is available. One deals with a dense and quasi-static situation where the deformation rate nearly vanishes. The other deals with dilute and rapidly fluctuating grain velocities where particle inertia dominates. This project, funded by the NASA Microgravity Fluid Physics Program, aims to study this transitional regime via physical experiments and computer simulations. A conceptual model has been established as described below. There are two natural time scales in a granular flow. One is the travel time between two consecutive collisions and the other is the duration of a collision contact. At a very low shear-rate, the shear-induced particle velocity is low. Hence the travel time between collisions is longer than the contact time between colliding particles. Binary collisions prevail. As the shear-rate increases, the traveling time between collisions reduces and the probability of multiple collisions goes up. These particle groups disperse shortly after and new groups form. When shear-rate is further increased, clusters grow in size due to an increasing chance for free particles to join before groups have the time to disperse. The maximum cluster size may depend on the global concentration and material properties. As the solid concentration approaches zero, the cluster size goes to one particle diameter. The maximum possible cluster size under any condition is the container size, provided that the shear flow is inside a container. The critical shear-rates that dictate the initiation of the multiple contacts, and the size and lifetime of the collision clusters, are functions of the concentration also. A 'regime' theory has been proposed by Babic et al. This theory suggested that both the solid concentration, C , and the non-dimensional shear-rate, B , are important in determining the regimes of the granular constitutive law. Additional information is included in the original extended abstract.

Author

Granular Materials; Microgravity; Shear Flow; Computerized Simulation; Computational Fluid Dynamics

20030005565 Michigan Univ., Dept. of Chemical Engineering, Ann Arbor, MI USA

Aggregation and Gelation of Anisometric Colloidal Particles

Mohraz, Ali, Michigan Univ., USA; Solomon, Michael J., Michigan Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 244; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The quiescent and flow-induced structure and dynamics of colloidal aggregates and gels of anisometric particles are studied by means of static and dynamic light scattering. Ground-based studies of weak gels are possible due to the submicron size of the boehmite rod suspensions investigated; however, microgravity conditions would be required for more general studies. The properties of colloidal rod suspensions are compared to typical properties of spherical particle gels to understand the role of anisotropic excluded volume on gel structure and dynamics. The structure and dynamics of colloidal aggregates and gels have long been of scientific and technological interest; however, most research has focused on suspensions of spherical particles. Yet, aggregates and gels of anisometric particles - colloidal rods and platelets - may exhibit structure and dynamics that are quite different from spherical colloids. For example, suspensions of colloidal rods gel at extremely low volume fractions and form birefringent sediments. The rheology of solutions and gels of colloidal rods and platelets differs dramatically from that of colloidal spheres. Scientifically, studies with anisometric particles offer the opportunity to assess the role of anisotropic excluded volume and particle orientation in aggregates and gels. Technologically, anisometric colloids find use in a wide range of materials such as ceramics, polymer nanocomposites, well-bore drilling fluids and magnetic storage media. Model colloidal boehmite rods of approximately monodisperse dimension and aspect ratio have been synthesized according to the method of Philipse and coworkers. In aqueous solution, these materials undergo gelation upon the addition of divalent salt. by means of a novel grafting reaction and procedure for solvent refractive index matching, the rods have also been dispersed in mixed organic solvents. In this case, gelation is induced by means of depletion interaction. We report the effect of particle shape and anisotropic excluded volume

on the structure, rheology, and internal dynamics of colloidal gels. The quiescent structure of these gels is characterized over two decades in the scattering vector, q , by combined small and wide-angle light scattering. The effect of particle aspect ratio on the gel microstructure is studied in particular. Light scattering studies conducted as shear deformation is applied to the material quantify how colloidal aggregates are oriented and deformed by flow. The internal dynamics of the gels are quantified by means of photon correlation spectroscopy.

Author

Aggregates; Gelation; Anisotropy; Colloids; Light Scattering; Rheology

20030005566 National Center for Microgravity Research on Fluids and Combustion, Cleveland, OH USA

Splashing Droplets

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Current data on droplet breakup is scarce for the sizes and velocities typical of practical applications such as in spray combustion processes and coating processes. While much more representative of practical applications, the small spatial scales and rapid time-scales prevent detailed measurement of the internal fluid dynamics and liquid property gradients produced by impinging upon surfaces. Realized through the extended spatial and temporal scales afforded by a microgravity environment, an improved understanding of drop breakup dynamics is sought to understand and ultimately control the impingement dynamics of droplets upon surfaces in practical situations. The primary objective of this research will be to mark the onset of different 'splashing modes' and to determine their temperature, pressure and angle dependence for impinging droplets representative of practical fluids. In addition, we are modeling the evolution of droplets that do not initially splash but rather undergo a 'fingering' evolution observed on the spreading fluid front and the transformation of these fingers into splashed products. An example of our experimental data is presented below. These images are of Isopar V impacting a mirror-polished surface. They were acquired using a high-speed camera at 1000 frames per second. They show the spreading of a single droplet after impact and ensuing finger instabilities. Normal gravity experimental data such as this will guide low gravity measurements in the 2.2 second drop tower and KC-135 aircraft as available. Presently we are in the process of comparing the experimental data of droplet shape evolution to numerical models, which can also capture the internal fluid dynamics and liquid property gradients such as produced by impingement upon a heated surface. To-date isothermal numerical data has been modeled using direct numerical simulations of representative splashing droplets. The data obtained so far indicates that the present model describes well the droplet wall interactions to a point in time just before splash. Additional information is included in the original extended abstract.

Author

Drops (Liquids); Fluid Dynamics; Splashing; Microgravity; Pressure Dependence; Temperature Dependence

20030005567 Universidad Nacional Autonoma de Mexico, Inst. de Investigaciones en Materiales, Coyoacan, Mexico

Flow Around a Cylinder Immersed in a Dense Granular Flow

Chehata, D., Universidad Nacional Autonoma de Mexico, Mexico; Zenit, R., Universidad Nacional Autonoma de Mexico, Mexico; Wassgren, C. R., Purdue Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 262; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The flow around a fixed cylinder immersed in a uniform granular flow is studied experimentally. Experiments are performed in a tall vertical chute that produces a quasi two-dimensional granular flow. A storage bin at the top of the chute feeds glass particles into the channel while the mean velocity of the flow is controlled by varying the width of a hopper located at the channel exit. Measurements of the drag force acting on a fixed cylinder are made using a strain gauge force measurement system. The flow velocity field is measured through a transparent wall using particle image velocimetry analyses of high speed video recordings of the flow. Experiments are performed for a range of upstream particle velocities, cylinder diameters, and two diameters of glass particles. For the range of velocities studied, the drag force acting on the cylinder is independent of the mean flow velocity, contrary to what is expected from any ordinary fluid. The drag force scales with the asymptotic static stress state in a tall granular bed. The drag coefficient, defined in terms of a dynamic pressure, scales with the flow Froude number and a length scale parameter that accounts for the effective cylinder size. Although the drag force on the cylinder does not change with the upstream flow

velocity, the flow streamlines do, in fact, change with velocity. A large stagnation zone forms at the leading edge of the cylinder while at the trailing edge an empty wake is observed. The wake size increases with flow velocity.

Author

Two Dimensional Flow; Uniform Flow; Fluid Dynamics; Chutes; Flow Velocity; Particle Image Velocimetry; Flow Distribution; Aerodynamic Drag

20030005568 Purdue Univ., School of Mechanical Engineering, USA

Collisional Granular Flow Around an Immersed Cylinder

Wassgren, C. R., Purdue Univ., USA; Zenit, R., Universidad Nacional Autonoma de Mexico, Mexico; Karion, A., Naval Surface Warfare Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 263; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A two-dimensional collisional granular flow past an immersed cylinder is investigated using discrete element computer simulations. The drag force acting on the cylinder, F_d , is proportional to the upstream bulk density, ρ_∞ , where ρ is the upstream particle mass density and ν is the upstream solid fraction, the square of the upstream velocity, U_∞ , and the sum of the cylinder diameter, D , and surrounding particle diameter, d . The drag coefficient, defined as $C_d = (2F_d)/(\rho_\infty U_\infty^2 (D+d))$ has a strong dependence on the flow Knudsen number and a secondary weak dependence on the Mach number. The drag coefficient decreases slightly with decreasing coefficient of restitution and is relatively insensitive to the inter-particle friction coefficient. Bow shock structures and expansion fans similar to those observed in compressible fluid flows are also observed.

Author

Fluid Flow; Fluid Dynamics; Computerized Simulation; Aerodynamic Drag; Particle Mass; Cylinders

20030005569 NASA Glenn Research Center, Cleveland, OH USA

Fundamental Studies on Two-Phase Gas-Liquid Flows Through Packed Beds in Microgravity

Balakotaiah, Vemuri, Houston Univ., USA; McCreedy, Mark J., Notre Dame Univ., USA; Motil, Brian J., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 265-275; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

In the typical operation of a packed-bed reactor, gas and liquid flow simultaneously through a fixed bed of solid particles. Depending on the application, the particles can be of various shapes and sizes and provide for intimate contact and high rates of transport between the phases needed to sustain chemical or biological reactions. The packing may also serve as either a catalyst or as a support for growing biological material. NASA has flown two of these packed-bed systems in a microgravity environment with limited or no success. The goal of this research is to develop models (with scale-up capability) needed for the design of the physicochemical equipment to carry out these unit operations in microgravity. New insight will also lead to improvements in normal gravity operations. Our initial experiment was flown using an existing KC-135 two-phase flow rig with a modified test section. The test section is a clear polycarbonate rectangular column with a depth of 2.54 cm, a width of 5.08 cm, and 60 cm long. The column was randomly packed with spherical glass beads by slowly dropping the beads into the bed. Even though care was taken in handling the column after it was filled with packing, the alternating high and low gravity cycles with each parabola created a slightly tighter packed bed than is typically reported for this type. by the usual method of comparing the weight difference of a completely dry column versus a column filled with water, the void fraction was found to be .345 for both sizes of beads used. Five flush mounted differential pressure transducers are spaced at even intervals with the first location 4 cm from the inlet port and the subsequent pressure transducers spaced at 13 cm intervals along the column. Differential pressure data was acquired at 1000 Hz to adequately observe pulse formation and characteristics. Visual images of the flow were recorded using a high-speed SVHS system at 500 frames per second. Over 250 different test conditions were evaluated along with a companion set of tests in normal gravity. The flow rates, fluid properties and packing properties were selected to provide a range of several orders-of-magnitude for the important dimensionless parameters. Additional information is included in the original extended abstract.

Author

Two Phase Flow; Microgravity; Liquid-Vapor Interfaces; Fluid Dynamics; Interfacial Tension; Flow Distribution; Boundary Layers; Pulse Amplitude

20030005570 California Univ., Dept. of Chemical Engineering, Santa Barbara, CA USA

Phase-Field Methods for Structure Evolution in Sheared Multiphase Systems

Badalassi, Vittorio, California Univ., USA; Cenicerros, Hector, California Univ., USA; Banerjee, Sanjoy, California Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 276-277; In English; Also announced as 20030005526; Original contains color illustrations; Sponsored in part by an Academic Senate Junior Faculty Research Award

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A homogeneous disordered phase separates into ordered structures when quenched into a broken-symmetry phase. The competition of broken-symmetry phases to select an equilibrium state may be studied in terms of coarse-grained order parameters described by a suitable Landau free-energy function. A network of equilibrium-phase domains develops on quenching and coarsens with time with a topology that may be controlled by shear. We use three-dimensional simulations, in which time-dependent models for conserved-order parameters coupled to Navier-Stokes fluid models are solved, to investigate the evolution of such domains, e.g. spinodal decompositions of polymeric materials under shear. The numerical problems are formidable because of the strong nonlinearities inherent in the coupled model, and these are amongst the first 3D calculations undertaken. In linear shear fields we find stable nanostrings, also recently seen in experiments. The affinity of the ordered phases to boundaries plays a role in the form of the structures that develop, with stacked plate-like phase distributions emerging under certain conditions. Such methods appear quite promising for design and analysis of multiphase and complex fluid formulations. The behavior of foams in such conditions is of particular interest in microgravity environments. Additional information can be found in the original extended abstract.

Author

Fluid Dynamics; Multiphase Flow; Phase Transformations; Three Dimensional Models; Computerized Simulation; Order-Disorder Transformations

20030005571 Florida State Univ., Dept. of Chemical Engineering, Tallahassee, FL USA

Computational Techniques for Multiphase Flow and Transport in Microgravity Environments

Chella, Ravi, Florida State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 278-279; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

A mesoscopic approach is taken for modeling flow in multiphase systems, with the system characterized by a coarse-grained conserved order parameter that takes characteristic values in the bulk phases and varies continuously in a narrow interfacial region. This approach provides significant computational advantages over classical continuum approaches. This formulation has been extended to incorporate interactions with solid boundaries through modification of free energy functionals to include short-range and long range interactions with the walls. This approach has been implemented using a lattice-Boltzmann approach. Additional information can be found in the original extended abstract. Additional information is included in the original extended abstract.

Author

Multiphase Flow; Transport Properties; Microgravity; Three Dimensional Models; Mathematical Models; Shear Flow; Phase Separation (Materials)

20030005572 Connecticut Univ., Dept. of Mechanical Engineering, Storrs, CT USA

Experiments on Hydrodynamic and Thermal Behaviors of Thin Liquid Films Flowing Over a Rotating Disk Including Nucleate Boiling

Ozar, Basar, Connecticut Univ., USA; Cetegen, Baki M., Connecticut Univ., USA; Faghri, Amir, Connecticut Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 280; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Experiments on characterization of thin liquid films over stationary and rotating disks are described in this study. The thin liquid film is created by controlled liquid impingement by introducing deionized water from a flow collar at the center of an aluminum disk at a known initial film thickness with uniform radial velocity. Experiments were performed for a range of Reynolds numbers based on the liquid inlet gap height and velocity and (flow rates) between 238 (3.0 lpm) and 1188 (15.0 lpm). The angular speed of the disk was varied from 0 rpm to 300 rpm. Radial film thickness distribution was measured using a non-intrusive laser light reflection technique that enabled the measurement of the instantaneous film thickness over a finite segment of the disk. When the disk was stationary, a circular hydraulic jump was present. The liquid film thickness in the subcritical region (downstream of the hydraulic jump) was an order of magnitude greater than that in the supercritical region (upstream of the hydraulic jump) which was of the order of 0.3 mm. As the Reynolds number increased, the hydraulic jump migrated toward the edge of the disk.

In case of rotation, the liquid film thickness exhibited a maximum on the disk surface. The liquid film inertia and friction influenced the inner region where the film thickness progressively increased. The outer region where the film thickness decreased was primarily affected by the centrifugal forces. A flow visualization study of the thin film was also performed to determine the characteristics of the waves on the free surface. At high rotational speeds, radial waves were observed on the liquid film. It was also found that the tangent of the waves present on the liquid surface was a function of the ratio of local radial velocity and local azimuthal velocity. Radial temperature distribution was measured using an amplified thermocouple/slip ring arrangement. Local Nusselt number was seen to increase with flow rate and angular velocity. The inertia forces rather than rotation was found to have more significance on the Nusselt number at the inner parts of the disk. Semi-empirical correlations were presented in this study for the local and average Nusselt numbers. For nucleate boiling experiments, temperature profile over the disk was measured using the same amplified thermocouple/slip ring arrangement. Laser light reflection technique was utilized to measure the bubble size, its growth and motion. The bubbles were found to grow to diameters that were larger than the film thickness. The dynamics of bubble motion was characterized as a function of rotational speed of the disk, liquid flowrate over the disk as well as the overheat level.

Author

Film Thickness; Nucleate Boiling; Rotating Disks; Fluid Dynamics; Liquid Surfaces; Friction Drag; Fluid Flow

20030005574 Rutgers Univ., Dept. of Chemical and Biochemical Engineering, Piscataway, NJ USA

Instabilities and the Development of Density Waves in Gas-Particle and Granular Flows

Glasser, Benjamin J., Rutgers Univ., USA; Liss, Elizabeth D., Rutgers Univ., USA; Conway, Stephen L., Rutgers Univ., USA; Johri, Jayati, Rutgers Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 283-293; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The dynamics of gas-particle and granular flows impact numerous technologies related to the local utilization of Lunar and Martian soils and the Martian atmosphere. On earth, such flows occur in a large number of industries including the chemical, pharmaceutical, materials, mining and food industries.

Author

Dynamic Characteristics; Gas Dynamics; Fluid Flow; Computerized Simulation; Flow Velocity; Flow Characteristics; Density Distribution; Stability

20030005576 Worcester Polytechnic Inst., Dept. of Mechanical Engineering, MA USA

Stability and Heat Transfer Characteristics of Condensing Films

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The overall objective of this research is to investigate the fundamental physics of film condensation in reduced gravity. The condensation of vapor on a cool surface is important in many engineering problems, including spacecraft thermal control and also the behavior of condensate films that may form on the interior surfaces of spacecraft. To examine the effects of body force on condensing films, two different geometries have been tested in the laboratory: (1) a stabilizing gravitational body force (+1g, or condensing surface facing 'upwards') and (2) de-stabilizing gravitational body force (-1g, or 'downwards'). For each geometry, different fluid configurations are employed to help isolate the fluid mechanical and thermal mechanisms operative in condensing films. The fluid configurations are (a) a condensing film, and (b) a non-condensing film with film growth by mass addition by through the plate surface. Condensation experiments are conducted in a test cell containing a cooled copper or brass plate with an exposed diameter of 12.7 cm. The metal surface is polished to allow for double-pass shadowgraph imaging, and the test surface is instrumented with imbedded heat transfer gauges and thermocouples. Representative shadowgraph images of a condensing, unstable (-1g) n-pentane film are shown. The interfacial disturbances associated with the de-stabilizing body force leading to droplet formation and break-off can be clearly seen. The heat transfer coefficient associated with the condensing film is shown. The heat transfer coefficient is seen to initially decrease, consistent with the increased thermal resistance due to layer growth. For sufficiently long time, a steady value of heat transfer is observed, accompanied by continuous droplet formation and break-off. The non-condensing cell consists of a stack of thin stainless steel disks 10 cm in diameter mounted in a brass enclosure. The disks are perforated with a regular pattern of 361 holes each 0.25 mm in diameter. Non-condensing experiments in -1g have employed 50 cSt and 125 cSt silicone oil pumped through the perforated disks at a specified rate by a syringe micropump. The time to droplet

break-off and the disturbance wavelengths appear to decrease with increasing pumping rate. The ability to reliably perform multi-point, ultrasonic measurements of the film thickness has been demonstrated. A linear array of eight transducers of 6 mm diameter (with a beam footprint of comparable size) are pulsed with a square-wave signal at a frequency of 5 MHz and a pulse duration of approximately 0.3 s. For thin films (60 m to 2-3 mm in thickness) the layer thickness is determined by frequency analysis, where the received ultrasound pulse is Fourier transformed and the spacing between the peaks in the frequency spectrum is analyzed. For thicker layers (up to at least 1 cm in thickness), time-domain analysis is performed of the received ultrasound pulses to generate directly the layer thickness. A time-trace of the film thickness at a point using a single transducer in the linear array is shown for the case of an unstable (-1g) n-pentane film. The oscillations in film thickness are evidently due to the passage and/or shedding of droplets from the cooled plate surface. The entire transducer array was used to measure the changes in film thickness resulting from the passage of gravity waves generated either by an oscillating wall or the impact of a single droplet on the free surface of a film. The enclosure in both cases was 14 cm square and the transducer spacing was 12 mm. Best results were obtained using as test fluid a mixture of 50% glycerol and 50% water with a fluid layer thickness of 3-5 mm. In both cases the measured wavelengths and wave propagation speeds using the ultrasound technique compared reasonably well with those observed by optical imaging. Additional information can be found in the original extended abstract.

Author

Stability; Heat Transfer; Film Condensation; Microgravity; Fluid Dynamics; Film Thickness; Flow Geometry; Fluid Flow

20030005577 Honeywell International, Inc., Torrance, CA USA

Two-Phase Flow in Microchannels with Non-Circular Cross Section

Eckett, Chris A., Honeywell International, Inc., USA; Strumpf, Hal J., Honeywell International, Inc., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 308-318; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Two-phase flow in microchannels is of practical importance in several microgravity space technology applications. These include evaporative and condensing heat exchangers for thermal management systems and vapor cycle systems, phase separators, and bioreactors. The flow passages in these devices typically have a rectangular cross-section or some other non-circular cross-section; may include complex flow paths with branches, merges and bends; and may involve channel walls of different wettability. However, previous experimental and analytical investigations of two-phase flow in reduced gravity have focussed on straight, circular tubes. This study is an effort to determine two-phase flow behavior, both with and without heat transfer, in microchannel configurations other than straight, circular tubes. The goals are to investigate the geometrical effects on flow pattern, pressure drop and liquid holdup, as well as to determine the relative importance of capillary, surface tension, inertial, and gravitational forces in such geometries. An evaporative heat exchanger for microgravity thermal management systems has been selected as the target technology in this investigation. Although such a heat exchanger has never been developed at Honeywell, a preliminary sizing has been performed based on knowledge of such devices in normal gravity environments. Fin shapes considered include plain rectangular, offset rectangular, and wavy fin configurations. Each of these fin passages represents a microchannel of non-circular cross section. The pans at the inlet and outlet of the heat exchanger are flow branches and merges, with up to 90-deg bends. R-134a has been used as the refrigerant fluid, although ammonia may well be used in the eventual application.

Author

Two Phase Flow; Microchannels; Microgravity Applications; Flow Distribution; Interfacial Tension

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Gas Evolution in Rotating Electrochemical Systems Under Microgravity Condition

Kamotani, Yasuhiro, Case Western Reserve Univ., USA; Boonpongmanee, Thaveesak, Case Western Reserve Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 319-329; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The effect of gas evolution on mass and heat transfer in rotating electrochemical cells is being investigated experimentally, both in 1-g and in reduced gravity. This work is motivated by the need of efficient electrochemical cells in microgravity. In microgravity, gas bubbles that are generated in an electrochemical cell must be removed from the electrode surface. In the present work, we investigate a means to enhance heat and mass transfer and, at the same time, to remove gas bubbles effectively for electrochemical systems. Currently, we are investigating the effect of gas evolution on heat transfer. A cylindrical enclosure is rotated around its axis on a rotating table. The container diameter is 0.15 m and the depth is 0.05 m. The top wall is heated and the bottom wall is cooled. The container is filled with water. Without gas evolution, the flow in the cell is driven mainly by the

centrifugal buoyancy, which generates radially outward flow along the bottom wall and inward flow along the top wall. In the present experiment, the Ekman number (Ek) is very small ($1 \times 10(\exp -5)$ is less than Ek is less than $4 \times 10(\exp -5)$). Consequently, the radial flow is confined to relatively thin Ekman layers along the top and bottom walls. The fluid is mainly in solid-body rotation with the enclosure, but the radial flow induces additional azimuthal flow through the Coriolis force. As a result, the azimuthal flow is slower (faster) than the container rotation near the cold (hot) wall. In the present heat transfer experiment, we are in the so-called Ekman suction regime, where the centrifugal buoyancy is mainly balanced by the Coriolis force, so that the radial flow is very much suppressed. The main quantity of interest in the present experiment is the overall heat transfer rate from the hot to cold walls, non-dimensionalized as the average Nusselt number (Nu). The experimentally measured Nusselt is about 2, which agrees well with the numerical simulation that is being conducted to supplement the experiment. Since the radial flow is suppressed by the Coriolis force, in some tests we place partitions in the container to retard the azimuthal flow and to increase the heat transfer rate. It is shown that Nu more than doubles when the partitions are used.

Author

Gas Evolution; Microgravity; Nusselt Number; Electrochemical Cells; Rotating Bodies; Cylindrical Bodies; Heat Transfer

20030005579 Vanderbilt Univ., Dept. of Chemical Engineering, Nashville, TN USA

Adsorption Equilibrium for Separation of Carbon Monoxide and Carbon Dioxide for Mars ISRU

Walton, Krista S., Vanderbilt Univ., USA; LeVan, M. Douglas, Vanderbilt Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 330-341; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The overall goal of this part of our research is to determine experimentally the adsorption equilibrium data that will enable efficient design of a separation process to remove carbon dioxide from a CO/CO₂ mixture. An effective separation process will depend on the adsorbent capacity for both the strongly and weakly adsorbed components at the desired operating temperature and pressure ranges, as well as regeneration requirements. Pure component and binary adsorption isotherms are used to determine the most CO₂- selective adsorbent. A quick uptake of pure CO₂ on a given adsorbent at low pressures compared to the uptake of pure CO on the same adsorbent indicates that CO₂ molecules have a much stronger interaction with the adsorbent surface than CO. This is a necessary property for successful separation by adsorption. Adsorption isotherms are widely available in the literature for many pure components on various adsorbents. Pure component isotherms can be found in various publications and data handbooks for CO and CO₂ on activated carbon and many zeolites. However, the pressure range seldom extends beyond 300 kPa, and the temperature is usually limited as well. Binary adsorption data are much less abundant and are more difficult to measure experimentally. There are models that can predict binary adsorption from the pure component isotherms, but such models rarely provide the desired accuracy. Hence it is necessary to determine both pure component and binary adsorption isotherms to accurately design the separation system.

Author

Carbon Dioxide; Separators; Carbon Monoxide; Activated Carbon; Adsorbents

20030005580 NASA Glenn Research Center, Cleveland, OH USA

On the Motion of an Annular Film in Microgravity Gas-Liquid Flow

McQuillen, John B., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 342-351; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

Three flow regimes have been identified for gas-liquid flow in a microgravity environment: Bubble, Slug, and Annular. For the slug and annular flow regimes, the behavior observed in vertical upflow in normal gravity is similar to microgravity flow with a thin, symmetrical annular film wetting the tube wall. However, the motion and behavior of this film is significantly different between the normal and low gravity cases. Specifically, the liquid film will slow and come to a stop during low frequency wave motion or slugging. In normal gravity vertical upflow, the film has been observed to slow, stop, and actually reverse direction until it meets the next slug or wave.

Author

Liquid-Gas Mixtures; Two Phase Flow; Annular Flow; Bubbles; Gravitation; Microgravity

20030005582 Johns Hopkins Univ., Dept. of Mechanical Engineering, Baltimore, MD USA

A Numerical Method for Gas-Liquid Flows

Hao, Y., Johns Hopkins Univ., USA; Prosperetti, A., Johns Hopkins Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 364-375; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The numerical simulation of two-phase flow processes with heat transfer and phase change requires an accurate representation of the flow and temperature fields near gas-liquid (or vapor-liquid) interfaces. This circumstance renders rather problematic the use of several existing methods in which the interface is smeared over a few cells. The present method avoids this shortcoming by maintaining the interface sharp by means of a suitably modified front-tracking approach. In addition, the compressibility of the gas or vapor field can be accounted for, and realistic density ratios can be used. For the time being, the method has been developed and tested for three-dimensional adiabatic calculations. It has been found to perform very well, and its extension to the energy equation is planned for the near future.

Author

Liquid-Gas Mixtures; Flow Distribution; Two Phase Flow; Liquid-Vapor Interfaces; Heat Transfer

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Study of Co-Current and Counter-Current Gas-Liquid Two-Phase Flow Through Packed Bed in Microgravity

Revankar, Shripad T., Purdue Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 376-389; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The main goal of the project is to obtain new experimental data and development of models on the co-current and counter-current gas-liquid two-phase flow through a packed bed in microgravity and characterize the flow regime transition, pressure drop, void and interfacial area distribution, and liquid hold up. Experimental data will be obtained for earth gravity and microgravity conditions. Models will be developed for the prediction of flow regime transition, void fraction distribution and interfacial area concentration, which are key parameters to characterize the packed bed performance. Thus the specific objectives of the proposed research are to: (1) Develop experiments for the study of the gas liquid two-phase flow through the packed bed with three different flow combinations: co-current down flow, co-current upflow and counter current flow. (2) Develop pore scale and bed scale two-phase instrumentation for measurement of flow regime transition, void distribution and gas-liquid interfacial area concentration in the packed bed. (3) Obtain database on flow regime transition, pressure drop, void distribution, interfacial area concentration and liquid hold up as a function of bed characteristics such as bed particle size, porosity, and liquid properties such as viscosity and surface tension. (4) Develop mathematical model for flow regime transition, void fraction distribution and interfacial area concentration for co-current gas-liquid flow through the porous bed in gravity and micro gravity conditions. (4) Develop mathematical model for the flooding phenomena in counter-current gas-liquid flow through the porous bed in gravity and micro gravity conditions. The present proposal addresses the most important topic of HEDS-specific microgravity fluid physics research identified by NASA 's one of the strategic enterprises, OBPR Enterprise. The proposed project is well defined and makes efficient use of the ground-based parabolic flight research aircraft facility. The project spans for four years. The first two years are devoted to ground based flight definition experimental and modeling program. During the next two years microgravity flight tests are carried out using the ground-based parabolic flight research aircraft. The experimental program consists of a design of a packed bed loop using a scaling analysis, performing experiments for various parameters: bed diameter, packing size, liquid surface tension, and liquid viscosity. Figure 1 shows the schematic of the test loop. A packed bed sections of 15 cm diameter and 10 cm diameter are designed with sphere packing particles of diameter, 6 mm and 3 mm. The fluid combination used are : 1)water, air, (2) alcohol-water mixture (50%, 80% methanol) and air, and (3) glycerol-water mixture and air (50%, and 64% glycerol weight percent). The loop is instrumented to provide detailed measurement at pore and bed level parameters.

Author

Flow Distribution; Liquid Flow; Liquid-Gas Mixtures; Microgravity; Two Phase Flow; Gas Flow

20030005584 Texas A&M Univ., Dept. of Mechanical Engineering, College Station, TX USA

Augmentation of Performance of a Monogroove Heat Pipe with Electrohydrodynamic Conduction Pumping

Jeong, S. I., Texas A&M Univ., USA; Seyed-Yagoobi, J., Illinois Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 390; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The electrohydrodynamic (EHD) phenomena involve the interaction of electric fields and flow fields in a dielectric fluid medium. There are three types of EHD pumps; induction, ion-drag, and conduction. EHD conduction pump is a new concept which has been explored only recently. Net pumping is achieved by properly utilizing the heterocharge layers present in the vicinity of the electrodes. Several innovative electrode designs have been investigated. This paper presents an electrode design that generates pressure heads on the order of 600 Pa per one electrode pair at 20 kV with less than 0.08 W of electric power. The working fluid is the Refrigerant R-123. An EHD conduction pump consisting of six pairs of electrodes is installed in the liquid line of a mono-groove heat pipe. The heat transport capacity of the heat pipe is measured in the absence and presence of the EHD

conduction pump. Significant enhancements in the heat transport capacity of the heat pipe is achieved with the EHD conduction pump operating. Furthermore, the EHD conduction pump provides immediate recovery from the dry-out condition. The EHD conduction pump has many advantages, especially in the micro-gravity environment. It is simple in design, non-mechanical, and lightweight. It provides a rapid control of heat transfer in single-phase and two-phase flows. The electric power consumption is minimal with the very low acoustic noise level.

Author

Heat Pipes; Electrohydrodynamics; Electric Fields; Flow Distribution; Two Phase Flow; Heat Transfer

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Microgravity Boiling Enhancement Using Vibration-Based Fluidic Technologies

Smith, Marc K., Georgia Inst. of Tech., USA; Glezer, Ari, Georgia Inst. of Tech., USA; Heffington, Samuel N., Georgia Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 391-392; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Thermal management is an important subsystem in many devices and technologies used in a microgravity environment. The increased power requirements of new Space technologies and missions mean that the capacity and efficiency of thermal management systems must be improved. The current work addresses this need through the investigation and development of a direct liquid immersion heat transfer cell for microgravity applications. The device is based on boiling heat transfer enhanced by two fluidic technologies developed at Georgia Tech. The first of these fluidic technologies, called vibration-induced bubble ejection, is shown in Fig. 1. Here, an air bubble in water is held against a vibrating diaphragm by buoyancy. The vibrations at 440 Hz induce violent oscillations of the air/water interface that can result in small bubbles being ejected from the larger air bubble (Fig. 1a) and, simultaneously, the collapse of the air/water interface against the solid surface (Fig. 1b). Both effects would be useful during a heat transfer process. Bubble ejection would force vapor bubbles back into the cooler liquid so that they can condense. Interfacial collapse would tend to keep the hot surface wet thereby increasing liquid evaporation and heat transfer to the bulk liquid. Figure 2 shows the effect of vibrating the solid surface at 7.6 kHz. Here, small-scale capillary waves appear on the surface of the bubble near the attachment point on the solid surface (the grainy region). The vibration produces a net force on the bubble that pushes it away from the solid surface. As a result, the bubble detaches from the solid and is propelled into the bulk liquid. This force works against buoyancy and so it would be even more effective in a microgravity environment. The benefit of the force in a boiling process would be to push vapor bubbles off the solid surface, thus helping to keep the solid surface wet and increasing the heat transfer. The second fluidic technology to be employed in this work is a synthetic jet, shown schematically in Fig. 3. The jet is produced using a small, sealed cavity with a sharp-edged orifice on one side and a vibrating diaphragm on the opposite side. The jet is formed when fluid is alternately sucked into and then expelled from the cavity by the motion of the diaphragm. This alternating motion means that there is no net mass addition to the system. Thus, there is no need for input piping or complex fluidic packaging.

Author

Vibration; Microgravity Applications; Boiling; Fluidics; Microgravity; Capillary Waves

20030005596 NASA Marshall Space Flight Center, Huntsville, AL USA

Study of Fluid Flow Control in Protein Crystallization using Strong Magnetic Fields

Ramachandran, Narayanan, Universities Space Research Association, USA; Leslie, Fred, NASA Marshall Space Flight Center, USA; Ciszak, Ewa, NASA Marshall Space Flight Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 463-464; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

An important component in biotechnology, particularly in the area of protein engineering and rational drug design is the knowledge of the precise three-dimensional molecular structure of proteins. The quality of structural information obtained from X-ray diffraction methods is directly dependent on the degree of perfection of the protein crystals. As a consequence, the growth of high quality macromolecular crystals for diffraction analyses has been the central focus for biochemists, biologists, and bioengineers. Macromolecular crystals are obtained from solutions that contain the crystallizing species in equilibrium with higher aggregates, ions, precipitants, other possible phases of the protein, foreign particles, the walls of the container, and a likely host of other impurities. by changing transport modes in general, i.e., reduction of convection and sedimentation, as is achieved in "microgravity", researchers have been able to dramatically affect the movement and distribution of macromolecules in the fluid, and thus their transport, formation of crystal nuclei, and adsorption to the crystal surface. While a limited number of high quality crystals from space flights have been obtained, as the recent National Research Council (NRC) review of the NASA microgravity crystallization program pointed out, the scientific approach and research in crystallization of proteins has been mainly empirical

yielding inconclusive results. We postulate that we can reduce convection in ground-based experiments and we can understand the different aspects of convection control through the use of strong magnetic fields and field gradients. Whether this limited convection in a magnetic field will provide the environment for the growth of high quality crystals is still a matter of conjecture that our research will address. The approach exploits the variation of fluid magnetic susceptibility with concentration for this purpose and the convective damping is realized by appropriately positioning the crystal growth cell so that the magnetic susceptibility force counteracts terrestrial gravity. The general objective is to test the hypothesis of convective control using a strong magnetic field and magnetic field gradient and to understand the nature of the various forces that come into play. Specifically we aim to delineate causative factors and to quantify them through experiments, analysis and numerical modeling. Once the basic understanding is obtained, the study will focus on testing the hypothesis on proteins of pyruvate dehydrogenase complex (PDC), proteins E1 and E3. Obtaining high crystal quality of these proteins is of great importance to structural biologists since their structures need to be determined. Specific goals for the investigation are: 1. to develop an understanding of convection control in diamagnetic fluids with concentration gradients through experimentation and numerical modeling. Specifically solutal buoyancy driven convection due to crystal growth will be considered. 2. To develop predictive measures for successful crystallization in a magnetic field using analyses and numerical modeling for use in future protein crystal growth experiments. This will establish criteria that can be used to estimate the efficacy of magnetic field flow damping on crystallization of candidate proteins. 3. to demonstrate the understanding of convection damping by high magnetic fields to a class of proteins that is of interest and whose structure is as yet not determined. 4. to compare quantitatively, the quality of the grown crystals with and without a magnetic field. X-ray diffraction techniques will be used for the comparative studies. In a preliminary set of experiments, we studied crystal dissolution effects in a 5 Tesla magnet available at NASA Marshall Space Flight Center (MSFC). Using a Schlieren setup, a 1mm crystal of Alum (Aluminum-Potassium Sulfate) was introduced in a 75% saturated solution and the resulting dissolution plume was observed. The experiment was conducted both in the presence and absence of a magnetic field gradient. The magnet produces a gradient field of approx. 1 Tesla/cm. Image analysis of the recorded images indicated an enhanced plume velocity that was of the order of the measurement limit. For this experiment, both the gradient and gravity fields are in the same direction resulting in an enhanced effective gravity that tends to accelerate the observed plume velocity. While the results are not conclusive, pending further tests, it clearly points out the inadequacy of the MSFC magnet for conducting protein crystallization experiments and the need for a stronger magnet. In spacebased experiments, however, where the gravitational effects are small, only a weak magnetic field will be required to control or mitigate the effects of convective contamination.

Author

Fluid Flow; Protein Crystal Growth; Magnetic Fields; Molecular Structure; X Ray Diffraction

20030005600 Ohio State Univ., Dept. of Physics, Columbus, OH USA

Thermal Imaging of Convecting Opaque Fluids using Ultrasound

Xu, Hongzhou, Ohio State Univ., USA; Fife, Sean, Ohio State Univ., USA; Andereck, C. David, Ohio State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 487-499; In English; Also announced as 20030005526; Original contains color illustrations

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An ultrasound technique has been developed to non-intrusively image temperature fields in small-scale systems of opaque fluids undergoing convection. Fluids such as molten metals, semiconductors, and polymers are central to many industrial processes, and are often found in situations where natural convection occurs, or where thermal gradients are otherwise important. However, typical thermal and velocimetric diagnostic techniques rely upon transparency of the fluid and container, or require the addition of seed particles, or require mounting probes inside the fluid, all of which either fail altogether in opaque fluids, or necessitate significant invasion of the flow and/or modification of the walls of the container to allow access to the fluid. The idea behind our work is to use the temperature dependence of sound velocity, and the ease of propagation of ultrasound through fluids and solids, to probe the thermal fields of convecting opaque fluids non-intrusively and without the use of seed particles. The technique involves the timing of the return echoes from ultrasound pulses, a variation on an approach used previously in large-scale systems.

Author

Ultrasonics; Nonintrusive Measurement; Free Convection; Fluid Flow; Imaging Techniques; Thermal Analysis

20030005601 NASA Glenn Research Center, Cleveland, OH USA

Transient Mixing Driven by Buoyancy Flows

Duval, W. M. B., NASA Glenn Research Center, USA; Batur, C., Akron Univ., USA; Zhong, H., Akron Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 500-519; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Mixing driven by buoyancy-induced flows is of particular interest to microgravity processes, as the body force that governs the intensity of flow fields can be directly controlled. We consider a model experimental system to explore the dynamics of mixing which employs two miscible liquids inside a cavity separated initially by a divider. The two liquids are oriented vertically inside a rectangular cavity with constant width and height, and varying depths to span the range of a Hele-Shaw cell to a 3-D configuration. The two miscible liquids can be sufficiently diluted and died, for example water and deuterium oxide, such that a distinct interface exists across the divider. The transient mixing characteristic of the two fluids is addressed by following the Lagrangian history of the interface for various aspect ratios in the z-plane (depth variation) as well as a range of pulling velocities of the divider. The mixing characteristics of the two fluids are quantified from measurement of the length stretch of the interface and its flow field using respectively image processing techniques and Particle Imaging Velocimetry. Scaling analysis shows that the length stretch depends on four governing parameters, namely the Grashof number (Gr), Schmidt number (Sc), aspect ratio (Ar), and Reynolds number (Re). Variation of the Schmidt number is taken into account through thermophysical property variation. Thus our problem reduces to a codimension three bifurcation in parametric space for Gr, Ar, and Re.

Author

Buoyancy; Flow Distribution; Thermophysical Properties; Mixing; Liquid-Liquid Interfaces; Solubility

20030005602 New Orleans Univ., Dept. of Physics, LA USA

Geophysical Flows in Spherical Geometry from Electric Fields and Near-Critical Fluids

Hegseth, John, New Orleans Univ., USA; Roy, Arun, New Orleans Univ., USA; Oprisan, Ana, New Orleans Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 520-530; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The use of near-critical fluids allows important parameters (e.g., compressibility of supercritical fluids, density of gas and liquid phases, surface tension) to be easily varied by using small changes in temperature. These highly variable properties of near-critical fluids makes it possible to study interesting phenomena when external forces are applied to the fluid. In particular, I plan to study geophysical flows in a spherical capacitor. The spherical capacitor will exert a central polar (di-electrophoretic) force on a supercritical fluid. This creates a central body force on the hyper-compressible fluid with a resultant radial density gradient. Large-scale geophysical flows, analogous to a planetary liquid core, a planetary ocean or atmosphere, etc., could be studied when a Coriolis force is also applied in a rotating frame of reference. In this presentation, I will show experimental results in support of this goal.

Author

Electric Fields; Geophysical Fluids; Dielectrics; Compressible Fluids; Concentric Spheres

20030005604 Clarkson Univ., Dept. of Mechanical and Aeronautical Engineering, Potsdam, NY USA

Theory of Micro- and Macro- Encapsulation

Lin, S. P., Clarkson Univ., USA; Chen, J. N., Clarkson Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 543-544; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Macro-capsules are defined to be the capsules whose radii are larger than 100 mm. Micro capsules have radii between 100 mm and 10 mm. Continuum theory is valid for the investigation of macro-capsule and micro-capsules formation is expected to be valid up to the lower range of micro-encapsulation. The results we have obtained show that there are two independent interfacial modes of convective instability.

Author

Continuums; Stability; Encapsulating; Numerical Analysis

20030005605 City Univ. of New York, Dept. of Chemical Engineering, NY USA

Enhancing the Thermocapillary Migration of Bubbles Retarded by the Adsorption of Surfactant Impurities by Using Remobilizing Surfactants

Maldarelli, Charles, City Univ. of New York, USA; Balasubramaniam, R., National Center for Microgravity Research on Fluids and Combustion, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 545-546; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Thermocapillary migration is a method for moving bubbles in space in the absence of buoyancy. A temperature gradient is applied to the continuous phase in which a bubble is situated, and the applied gradient impressed on the bubble surface causes one pole of the drop to be cooler than the opposite pole. As the surface tension is a decreasing function of temperature, the cooler pole pulls at the warmer pole, creating a flow which propels the bubble in the direction of the warmer fluid. A major impediment

to the practical use of thermocapillarity to direct the movement of bubbles in space is the fact that surfactant impurities which are unavoidably present in the continuous phase can significantly reduce the migration velocity. A surfactant impurity adsorbed onto the bubble interface is swept to the trailing end of the bubble. When bulk concentrations are low (which is the case with an impurity), diffusion of surfactant to the front end is slow relative to convection, and surfactant collects at the back end of the bubble. Collection at the back lowers the surface tension relative to the front end setting up a reverse tension gradient. (This can also be the case if kinetic desorption of surfactant at the back end of the bubble is much slower than convection.) For buoyancy driven bubble motions in the absence of a thermocapillarity, the tension gradient opposes the surface flow, and reduces the surface and terminal velocities (the interface becomes more solid-like and bubbles translate as solid particles). When thermocapillary forces are present, the reverse tension gradient set up by the surfactant accumulation reduces the temperature induced tension gradient, and can decrease to near zero the bubble's thermocapillary velocity. The objective of our research is to develop a method for enhancing the thermocapillary migration of bubbles which have been retarded by the adsorption onto the bubble surface of a surfactant impurity. Our remobilization theory proposes to use surfactant molecules which kinetically rapidly exchange between the bulk and the surface and are at high bulk concentrations.

Author

Adsorption; Bubbles; Impurities; Surfactants; Thermocapillary Migration

20030005606 Iowa Univ., Dept. Hydrosience and Engineering, Iowa City, IA USA

Rivulet Dynamics with Variable Gravity and Wind Shear

Wang, S., Iowa Univ., USA; McAlister, G., Iowa Univ., USA; Marshall, J. S., Iowa Univ., USA; Ettema, R., Iowa Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 547-555; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

A combined computational and experimental study is conducted of the development of rivulets from a liquid sheet driven by wind shear in different gravitational states. The study concentrates on the effect of the normal component of gravity on rivulet formation and evolution. Understanding of rivulet development in the presence of wind shear is important for a number of coating processes, for modeling development of ice rivulets on aircraft wings and of water motion on vehicle windshields, and for modeling the breakup of annular flow in a tube into a rivulet flow regime. The current study is at the midway point of a four-year project. The experimental part of the project has focused on the dynamics of gravity- and wind-driven rivulets. The experimental setup comprises a small "rivulet windtunnel", which consists of a flat plate into which a liquid is injected at an upstream location, and through which air flow passes. The entire setup is mounted on a mobile cart that can be tilted to angles varying from 0 degrees to 90 degrees. Preliminary experiments revealed significant differences in rivulet dynamics for gravity-driven and shear-driven cases. Gravity-driven rivulets initially formed as a lobe extending from the liquid source, which flowed for a short distance straight down the base surface and then eventually adopted a meandering form. Shear-driven rivulets start out in a similar manner to gravity-driven rivulets, but instead of extending as a long liquid finger the shear-driven rivulets exhibit an interesting phenomenon that we refer to as "blobbing". Blobbing is a cyclical process whereby the rivulet progresses by formation of blobs, which enlarge and oscillate in the air flow. After some time a lobe in the blob's downstream side develops and the liquid extends downstream, thus draining the blob. The process then repeats at a downstream location.

Author

Gravitation; Wind Shear; Air Flow; Pressure Distribution

20030005608 Oklahoma Univ., School of Aerospace and Mechanical Engineering, Norman, OK USA

Submerged Gas Injection from a Tube in Microgravity

Carrera, J., Oklahoma Univ., USA; Parthasarathy, R. N., Oklahoma Univ., USA; Gollahalli, S. R., Oklahoma Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 571-581; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The effects of buoyancy on the flow regimes, the bubble characteristics, and the bubble detachment mechanisms of submerged gas injection from a free-standing capillary tube were studied. The effects of liquid coflow, reduced surface tension, and increased viscosity were also analyzed. The microgravity experiments were carried out in the 2.2 Second Drop Tower at the NASA Glenn Research Center. The two-phase flow rig (97cm x 41cm x 84 cm) was totally autonomous from the instant of release in the drop tower; photographs of the bubbles were captured by a high-speed camera and stored on the onboard computer. A Lexan rectangular test section with the dimensions: 5cm x 5cm and 41cm in height was used. The injection was vertically upwards from

a free-standing tube of 0.51mm in diameter and 150mm in length. The dimensions of the test section ensured that the confinement effects on the bubble formation were minimized for low gas flow rates.

Author

Buoyancy; Gas Injection; Microgravity; Two Phase Flow; Capillary Tubes

20030005609 Northwestern Univ., Dept. of Engineering Science and Applied Mathematics, Evanston, IL USA

Resonant Interactions, Multi-Frequency Forcing, and Faraday Wave Pattern Control

Silber, Mary, Northwestern Univ., USA; Porter, Jeff, Northwestern Univ., USA; Topaz, Chad M., Northwestern Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 582; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Standing surface waves form on a layer of fluid when it is subjected to a sufficiently strong periodic acceleration in the vertical direction. There have been numerous theoretical and experimental investigations of pattern formation in this so-called Faraday wave system in the last 15 years or so, in part because it exhibits patterns not seen in other systems (rhombic and triangular patterns, quasipatterns, superlattice patterns, localized structures akin to oscillons, etc.). Hence it provides a versatile framework in which to develop and test our general understanding of the nonlinear pattern formation process in hydrodynamic systems. However, this versatility comes at some cost. Specifically, many of the more exotic patterns are only realized when the periodic forcing function contains more than one frequency component; the introduction of nonsinusoidal periodic forcing functions leads to a large control parameter space that is difficult to fully characterize. For example, there is an increase from 2 parameters (frequency and amplitude) to 5 parameters in the next simplest case of two-frequency forcing (frequencies, amplitudes and relative phase). We report on research that helps explain the role of each of the forcing function parameters in the pattern formation process. We focus on resonant triad interactions and their contribution to the weakly nonlinear pattern formation process for two-frequency forced parametrically excited surface waves.

Author

Surface Waves; Resonant Frequencies; Nonlinearity; Standing Waves; Faraday Effect; Control Theory

20030005611 Pittsburgh Univ., Dept. of Physics and Astronomy, Pittsburgh, PA USA

Thermal Convection in Two-Dimensional Soap Films

Zhang, Jie, Pittsburgh Univ., USA; Wu, X. L., Pittsburgh Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 585-586; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Thermal convection in a fluid is a common phenomenon. Due to thermal expansion, the light warm fluid at the bottom tends to rise and the cold, heavier fluid at the top tends to fall. This so-called thermal convection exists in earth atmosphere and in oceans. It is also an important mechanism by which energy is transported in stars. In this study we investigate thermal convection in a vertical soap film.

Author

Soaps; Fluid Flow; Free Convection; Thin Films; Two Dimensional Flow

20030005612 SASKatchewan Univ., Microgravity Research Group, SASKatoon, SASKatchewan Canada

An Observation of Film Thickness and Local Pressure in Upward and Downward Annular and Two-Phase Flow in Microgravity, Hypergravity and Normal Gravity

Gabriel, Kamiel S., SASKatchewan Univ., Canada; Manz, Devon L., SASKatchewan Univ., Canada; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 588-595; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

The phenomenon of two-phase flow in a near weightless environment (or microgravity) is becoming increasingly important. Two-phase flow loops are used in advanced spacecraft thermal management systems and also occur during the transfer of cryogenic propellants. On earth, twophase annular flow is common in power plants and many chemical processing plants. The liquid film along the tube wall plays a large role in mass and momentum transfer, featuring a complex wave structure. It is the wave structure phenomenon relating to the pressure and film thickness time trace that is the current interest in this investigation.

Author

Film Thickness; Gravitation; Microgravity; Two Phase Flow; Annular Flow; Pressure Distribution

20030005613 Tyumen State Univ., Liquid Microgravity Technology Lab., Tyumen, Russia

Photoinduced Capillary Motion of Drops and Bubbles

Bezuglyi, B. A., Tyumen State Univ., Russia; Ivanova, N. A., Tyumen State Univ., Russia; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 596; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Bubbles and drops are inhering in many liquid processes on Earth (microfluidics, MEMS technology, flows through porous media etc.) and in space laboratory under microgram conditions (preparation composite materials, degassing of liquefied matter, recycling of waste material). They could have affected these processes significantly. Therefore the study of behavior these capillary objects is necessary in order to develop the efficient methods of manipulation of them in situ. The best solution of such problem is the use of surface forces, which are aroused when the surface tension locally is departed from its equilibrium value as a result of thermal, concentration or electrical perturbations at interface. Among the known methods of control of surface tension the most promising is the thermal one. However, the generation of motion of capillary objects by the thermal gradients imposed in liquid bulk (or along solid substrate) by conduction is a passive method, which requires large amount of energy. In this paper the new method of generation of motion of bubbles and drops in microchannels or Hele-Shaw cells are reported. This method based on photoinduced solutocapillary convection discovered by Bezuglyi.

Author

Bubbles; Drops (Liquids); Convection; Thermocapillary Migration; Microchannels

20030005614 West Virginia Univ., Dept. of Mechanical and Aerospace Engineering, Morgantown, WV USA

Observations of Confinement of a Paramagnetic Liquid in Model Propellant Tanks in Microgravity by the Kelvin Force

Kuhlman, John, West Virginia Univ., USA; Gray, Donald D., West Virginia Univ., USA; Barnard, Austin, West Virginia Univ., USA; Hazelton, Jennifer, West Virginia Univ., USA; Lechlitter, Matthew, West Virginia Univ., USA; Starn, Andrew, West Virginia Univ., USA; Battleson, Charles, West Virginia Univ., USA; Glaspell, Shannon, West Virginia Univ., USA; Kreitzer, Paul, West Virginia Univ., USA; Lechlitter, Michelle, West Virginia Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 597-608; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The magnetic Kelvin force has been proposed as an artificial gravity to control the orientation of paramagnetic liquid propellants such as liquid oxygen in a microgravity environment. This paper reports experiments performed in the NASA "Weightless Wonder" KC-135 aircraft, through the Reduced Gravity Student Flight Opportunities Program. The aircraft flies through a series of parabolic arcs providing about 25 s of microgravity in each arc. The experiment was conceived, designed, constructed, and performed by the undergraduate student team and their two faculty advisors. Two types of tanks were tested: square-base prismatic tanks 5 cm x 5 cm x 8.6 cm and circular cylinders 5 cm in diameter and 8.6 cm tall. The paramagnetic liquid was a 3.3 molar solution of MnCl₂ in water. Tests were performed with each type of tank filled to depths of 1 cm and 4 cm. Each test compared a pair of tanks that were identical except that the base of one was a pole face of a 0.6 Tesla permanent magnet. The Kelvin force attracts paramagnetic materials toward regions of higher magnetic field. It was hypothesized that the Kelvin force would hold the liquid in the bottom of the tanks during the periods of microgravity. The tanks were installed in a housing that could slide on rails transverse to the flight direction. by manually shoving the housing, an identical impulse could be provided to each tank at the beginning of each period of microgravity. The resulting fluid motions were videotaped for later analysis.

Author

Artificial Gravity; Microgravity; Permanent Magnets; Propellant Tanks; Liquid Rocket Propellants; Mathematical Models

20030005684 NASA Glenn Research Center, Cleveland, OH USA

Visualization of Flows in Packed Beds of Twisted Tapes

Hendricks, R. C., NASA Glenn Research Center, USA; Braun, M. J., Akron Univ., USA; Peloso, D., Akron Univ., USA; Athavale, M. M., CFD Research Corp., USA; Mullen, R. L., Case Western Reserve Univ., USA; November 2002; 59p; In English; Second Pacific Symposium on Flow Visualization and Image Processing, 16-19 May 1999, Honolulu, HI, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 910-30-11

Report No.(s): NASA/TM-2002-208914; NAS 1.15:208914; E-11550-1; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A videotape presentation of the flow field in a packed bed of 48 twisted tapes which can be simulated by very thin virtual cylinders has been assembled. The indices of refraction of the oil and the Lucite twisted tapes were closely matched, and the flow was seeded with magnesium oxide particles. Planar laser light projected the flow field in two dimensions both along and transverse to the flow axis. The flow field was three dimensional and complex to describe, yet the most prominent finding was flow threads.

It appeared that axial flow spiraled along either within the confines of a virtual cylindrical boundary or within the exterior region, between the tangency points, of the virtual cylinders. Random packing and bed voids created vortices and disrupted the laminar flow but minimized the entrance effects. The flow-pressure drops in the packed bed fell below the Ergun model for porous-media flows. Single-twisted-tape results of Smithberg and Landis (1964) were used to guide the analysis. In appendix A the results of several investigators are scaled to the Ergun model. Further investigations including different geometric configurations, computational fluid dynamic (CFD) gridding, and analysis are required.

Author

Flow Distribution; Computational Fluid Dynamics; Axial Flow; Laminar Flow

20030005729 CFD Research Corp., Huntsville, AL USA

Mixed-Dimensionality VLSI-Type Configurable Tools for Virtual Prototyping of Biomicrofluidic Devices and Integrated Systems *Final Report, Jun. 1998-Aug. 2001*

Makhijani, Vinod B.; Przekwas, Andrzej J.; Oct. 2002; 186p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-2-0152; AF Proj. E117

Report No.(s): AD-A408562; AFRL-IF-RS-TR-2002-270; No Copyright; Avail: Defense Technical Information Center (DTIC)

This report presents results of a DARPA/MTO Composite CAD Project aimed to develop a comprehensive microsystem CAD environment, CFD-ACE+ Multiphysics, for bio and microfluidic devices and complete microsystems. The project began in July 1998, and was a three-year team effort between CFD Research Corporation, California Institute of Technology (CalTech), University of California, Berkeley (UCB), and Tanner Research, with Mr. Don Verlee from Abbott Labs participating as a consultant on the project. The overall objective of this project was to develop, validate and demonstrate several applications of a user-configurable VLSI-type mixed-dimensionality software tool for design of biomicrofluidics devices and integrated systems. The developed tool would provide high fidelity 3-D multiphysics modeling capability, 1-D fluidic circuits modeling, and SPICE interface for system level simulations, and mixed-dimensionality design. It would combine tools for layouts and process fabrication, geometric modeling, and automated grid generation, and interfaces to EDA tools (e.g. Cadence) and MCAD tools (e.g. ProE).

DTIC

Software Engineering; Computational Fluid Dynamics; Computer Aided Design; Fluidic Circuits

20030005740 Air Force Research Lab., Air Vehicles Directorate, Wright-Patterson AFB, OH USA

A Modified Simple Shooting Method for Solving Two-Point Boundary-Value Problems

Holsapple, Raymond; Venkataraman, Ram; Doman, David B.; Oct. 2002; 10p; In English

Report No.(s): AD-A408435; AFRL-VA-WP-TP-2002-327; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In the study of mechanics and optimal control, one often encounters what is called a two-point boundary-value problem (TPBVP). A couple of methods exist for solving these problems, such as the Simple Shooting Method (SSM) and its variation, the Multiple Shooting Method (MSM). In this paper a new method is proposed that was designed from the favorable aspects of both the SSM and the MSM. The Modified Simple Shooting Method (MSSM) sheds undesirable aspects of both previously mentioned methods to yield a superior, faster method for solving TPBVPs. The convergence of the MSSM is proven under mild conditions on the TPBVP. A comparison of the MSM and the MSSM is made for a problem where both methods converge. We also provide a second example where the MSM fails to converge while the MSSM converges rapidly.

DTIC

Boundary Value Problems; Optimal Control; Problem Solving; Fluid Mechanics

20030005807 NASA Langley Research Center, Hampton, VA USA

Boundary Layer Transition Correlations and Aeroheating Predictions for Mars Smart Lander

Hollis, Brian R., NASA Langley Research Center, USA; Liechty, Derek S., NASA Langley Research Center, USA; [2002]; 13p; In English; 32nd AIAA Fluid Dynamics Conference and Exhibit, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-2745; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Laminar and turbulent perfect-gas air, Navier-Stokes computations have been performed for a proposed Mars Smart Lander entry vehicle at Mach 6 over a free stream Reynolds number range of $6.9 \times 10(\text{exp } 6)/\text{m}$ to $2.4 \times 10(\text{exp } 7)/\text{m}$ ($2.1 \times 10(\text{exp } 6)/\text{ft}$ to $7.3 \times 10(\text{exp } 6)/\text{ft}$) for angles-of-attack of 0-deg, 11-deg, 16-deg, and 20-deg, and comparisons were made to wind tunnel heating data obtained at the same conditions. Boundary layer edge properties were extracted from the solutions and used to correlate experimental data on the effects of heat-shield penetrations (bolt-holes where the entry vehicle would be attached to the propulsion

module during transit to Mars) on boundary-layer transition. A non-equilibrium Martian-atmosphere computation was performed for the peak heating point on the entry trajectory in order to determine if the penetrations would produce boundary-layer transition by using this correlation.

Author

Boundary Layer Transition; Correlation; Aerodynamic Heating; Mars Atmosphere; Landing; Temperature Effects

20030005809 NASA Langley Research Center, Hampton, VA USA

An Irreversible Constitutive Law for Modeling the Delamination Process using Interface Elements

Goyal, Vinay K., Virginia Polytechnic Inst. and State Univ., USA; Johnson, Eric R., Virginia Polytechnic Inst. and State Univ., USA; Davila, Carlos G., NASA Langley Research Center, USA; Jaunky, Navin, Institute for Computer Applications in Science and Engineering, USA; [2002]; 12p; In English; 43rd AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NCC1-398

Report No.(s): AIAA Paper 2002-1576; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

An irreversible constitutive law is postulated for the formulation of interface elements to predict initiation and progression of delamination in composite structures. An exponential function is used for the constitutive law such that it satisfies a multi-axial stress criterion for the onset of delamination, and satisfies a mixed mode fracture criterion for the progression of delamination. A damage parameter is included to prevent the restoration of the previous cohesive state between the interfacial surfaces. To demonstrate the irreversibility capability of the constitutive law, steady-state crack growth is simulated for quasi-static loading-unloading cycle of various fracture test specimens.

Author

Axial Stress; Composite Structures; Crack Propagation; Delaminating; Exponential Functions; Mathematical Models

20030005825 Garrett Turbine Engine Co., Phoenix, AZ USA

Dilution Jet Mixing Phase I Program Final Report

Srinivasan, R., Garrett Turbine Engine Co., USA; Berenfeld, A., Garrett Turbine Engine Co., USA; Mongia, H. C., Garrett Turbine Engine Co., USA; November 1982; 160p; In English

Contract(s)/Grant(s): NAS3-22110

Report No.(s): NASA/CR-168031; NAS 1.26:168031; GARRETT-21-4302; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The main objective of the NASA Dilution Jet Mixing Phase I Program was to quantify by means of parametric tests the effect of the following on the mixing of a row of jets with a confined cross-flow. 1) Jet to mainstream density ratio; 2) Flow area convergence as encountered in transition sections; and 3) Non-uniform mainstream profile upstream of dilution orifices. The general conclusions derived from Phase I work are: 1) Jet spreading rate in transverse direction is increased with increasing J, H/D and with decreasing S/D; 2) The density ratio has only a second order effect on the jet mixing characteristics for a constant momentum ratio; 3) The temperature distributions in the jet mixing region are strongly influenced by the undisturbed mainstream profile. Therefore, a superposition of the mainstream profile on the correlations for isothermal mainstream conditions yields good agreement with data; and 4) Flow area convergence enhances mixing in radial and transverse directions. An asymmetric convergent duct with flat wall injection has the same jet mixing characteristics as a symmetric convergent duct. An asymmetric convergent duct with slant wall injection has a faster jet spreading rate in the transverse direction.

Author

Jet Mixing Flow; Performance Tests; Temperature Distribution; Fluid Jets; Cross Flow

20030005863 Garrett Turbine Engine Co., Phoenix, AZ USA

Dilution Jet Mixing Phase II Program Final Report

Srinivasan, R., Garrett Turbine Engine Co., USA; Coleman, E., Garrett Turbine Engine Co., USA; Johnson, K., Garrett Turbine Engine Co., USA; June 1984; 238p; In English

Contract(s)/Grant(s): NAS3-22110

Report No.(s): NASA/CR-174624; NAS 1.26:174624; GARRETT-21-4804; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

The main objectives of the NASA Dilution Jet Mixing Phase II were to quantify the mixing of opposed rows of jets (two-sided injection) in a confined cross-flow. Parametric tests were performed to determine the effects of the following on jet mixing

characteristics: 1) Orifice spacing to diameter ratio, S/D ; 2) Duct height to diameter ratio, $H(\text{sub } 0)/D$; 3) Jet-to-mainstream momentum flux ratio, J ; 4) Non-uniform mainstream profile upstream of the dilution orifices; and 5) Flow area convergence. The general conclusions derived from the Phase II efforts are: 1) Jet penetrations for two-sided injections are less than that for single-sided injections (investigated in Phase I), but the jet spreading rates are faster for a given momentum ratio and orifice plate; 2) Flow area convergence generally enhances mixing. The mixing characteristics with asymmetric and symmetric convergence are similar; 3) For constant momentum ratio, the optimum $S/H(\text{sub } 0)$ with in-line injections is one-half of the optimum value for single-sided injections. For staggered injections, the optimum $S/H(\text{sub } 0)$ is twice the optimum value for single-sided injection; and 4) The correlations developed in this program predict the temperature distributions within first order accuracy. They provide a useful tool for predicting jet trajectory and temperature profiles in the dilution zone with two-sided jet injections.

Author

Jet Mixing Flow; Combustion; Performance Tests; Upstream; Injection; Fluid Jets; Cross Flow

20030005920 NASA Langley Research Center, Hampton, VA USA

Control of Inflow Distortion in a Scarf Inlet

Gerhold, Carl H., NASA Langley Research Center, USA; Clark, Lorenzo R., NASA Langley Research Center, USA; Biedron, Robert T., NASA Langley Research Center, USA; [2002]; 10p; In English; 8th AIAA/CESA Aeroacoustics Conference, 16-18 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-2432; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The scarf inlet has the potential to reduce aircraft inlet noise radiation to the ground by reflecting it into the space above the engine. Without forward motion of the engine, the non-symmetry of the inlet causes inflow distortion which generates noise that is greater than the noise reduction of the scarf. However, acoustic evaluations of aircraft engines are often done on static test stands. A method to reduce inflow distortion by boundary layer suction is proposed and evaluated using a model of a high bypass ratio engine located in an anechoic chamber. The design goal of the flow control system is to make the inflow to the inlet circumferentially uniform and to eliminate reversed flow. This minimizes the inflow distortion and allows for acoustic evaluation of the scarf inlet on a static test stand. The inlet boundary layer suction effectiveness is evaluated both by aerodynamic and by acoustic measurements. Although the design goal is not met, the control system is found to have a beneficial effect on the engine operation, reducing blade stall and speed variation. This is quantified by two acoustic benefits, reduction both of the variability of tone noise and of the low frequency wideband noise due to the inflow distortion. It is felt that a compromise in the manufacture of the control hardware contributes to the inability of the control system to perform as expected from the analysis. The control system with sufficient authority is felt to have the potential to permit reliable acoustic testing in a static configuration of engines with non-symmetric inlets. Because the control system can improve operation of the engine, it may also have the potential to reduce noise and vibration and enhance engine longevity during low speed ground operations in the terminal area.

Author

Acoustic Measurement; Airspeed; Boundary Layers; Control Systems Design; Engine Inlets; Vibration

20030005924 Academy of Sciences (USSR), Unst. of Theoretical and Applied Mechanics, Novosibirsk, USSR

Experimental Study of Stability and Transition of Hypersonic Boundary Layer Around Blunted Cone Final Report, 27 Nov. 2000-27 Nov 2001

Maslov, Anatoly A.; Dec. 2001; 71p; In English; Original contains color images

Report No.(s): AD-A408241; ISTC-1863-2000; No Copyright; Avail: Defense Technical Information Center (DTIC)

The objective of this project is to basic research of stability and transition of hypersonic boundary layer around blunted cone. Next results is obtained: -experimental data on the position of the laminar-turbulent transition in the boundary layer of a cone with different nose bluntness for Mach 6; -experimental data on the characteristics of natural disturbances in the hypersonic boundary layer of a blunted cone for Mach 6; -experimental data on the evolution of artificial disturbances, excited in the hypersonic boundary layer on a blunted cone for Mach 6. Acquired experimental data could be used for validation of numerical techniques. Using of obtained data will help to more accurate prediction of laminar-turbulent transition location and thereby heat fluxes on hypersonic vehicles.

DTIC

Boundary Layer Flow; Hypersonic Flow; Stability; Blunt Bodies; Data Acquisition

20030006286 Massachusetts Inst. of Tech., Cambridge, MA USA

Micro-Fluidic Chemical Reactor Systems: Development, Scale-Up and Demonstration *Final Report, Jun. 1997-Sep. 2001*

Jensen, Klavs F.; Nov. 2002; 23p; In English; Original contains color images

Contract(s)/Grant(s): F30602-97-2-0100; AF Proj. E117

Report No.(s): AD-A408485; AFRL-IF-RS-TR-2002-295; No Copyright; Avail: Defense Technical Information Center (DTIC)

This report summarized advances in microfluidic chemical reactor systems obtained using microfabrication techniques. Using these techniques, reduction in size and integration of multiple functions for chemical reactor systems were realized. Issues in combining microfluidic components, sensors and control elements into a micro chemical system were also explored.

DTIC

Chemical Reactors; Fluidics

20030006442 NASA Langley Research Center, Hampton, VA USA

Flow Control Analysis on the Hump Model with RANS Tools

Viken, Sally A., NASA Langley Research Center, USA; Vatsa, Veer N., NASA Langley Research Center, USA; Rumsey, Christopher L., NASA Langley Research Center, USA; Carpenter, Mark H., NASA Langley Research Center, USA; [2003]; 29p; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2003-0218; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A concerted effort is underway at NASA Langley Research Center to create a benchmark for Computational Fluid Dynamic (CFD) codes. both unstructured and structured, against a data set for the hump model with actuation. The hump model was tested in the NASA Langley 0.3-m Transonic Cryogenic Tunnel. The CFD codes used for the analyses are the FUN2D (Full Unstructured Navier-Stokes 2-Dimensional) code, the structured TLNS3D (Thin-Layer Navier-Stokes 3-Dimensional) code, and the structured CFL3D code, all developed at NASA Langley. The current investigation uses the time-accurate Reynolds-Averaged Navier-Stokes (RANS) approach to predict aerodynamic performance of the active flow control experimental database for the hump model. Two-dimensional computational results verified that steady blowing and suction and oscillatory suction/blowing can be used to significantly reduce the separated flow region on the model. Discrepancies do exist between the CFD results and experimental data in the region downstream of the slot with the largest differences in the oscillatory cases. Overall, the structured CFD codes exhibited similar behavior with each other for a wide range of control conditions, with the unstructured FUN2D code showing moderately different results in the separated flow region for the suction and oscillatory cases.

Author

Flow Distribution; Reynolds Averaging; Navier-Stokes Equation; Computational Fluid Dynamics; Wind Tunnel Tests; Active Control; Models

20030006678 NASA Langley Research Center, Hampton, VA USA

Boundary Layer Transition Correlations and Aeroheating Predictions for Mars Smart Lander

Hollis, Brian R., NASA Langley Research Center, USA; Liechty, Derek S., NASA Langley Research Center, USA; [2002]; 13p; In English; 32nd AIAA Fluid Dynamics Conference and Exhibit, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-2745; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Laminar and turbulent perfect-gas air, Navier-Stokes computations have been performed for a proposed Mars Smart Lander entry vehicle at Mach 6 over a free stream Reynolds number range of $6.9 \times 10^6/m$ to $2.4 \times 10^7/m$ ($2.1 \times 10^6/ft$ to $7.3 \times 10^6/ft$) for angles-of-attack of 0-deg, 11-deg, 16-deg, and 20-deg, and comparisons were made to wind tunnel heating data obtained at the same conditions. Boundary layer edge properties were extracted from the solutions and used to correlate experimental data on the effects of heat-shield penetrations (bolt-holes where the entry vehicle would be attached to the propulsion module during transit to Mars) on boundary-layer transition. A non-equilibrium Martian-atmosphere computation was performed for the peak heating point on the entry trajectory in order to determine if the penetrations would produce boundary-layer transition by using this correlation.

Author

Boundary Layer Transition; Correlation; Aerodynamic Heating; Temperature Effects; Ideal Gas

20030006685 NASA Glenn Research Center, Cleveland, OH USA

Toward an Efficient Icing CFD Process Using an Interactive Software Toolkit--SmaggIce 2D

Vickerman, Mary B., NASA Glenn Research Center, USA; Choo, Yung K., NASA Glenn Research Center, USA; Schilling,

Herbert W., NASA Glenn Research Center, USA; Baez, Marivell, NASA Glenn Research Center, USA; Braun, Donald C., NASA Glenn Research Center, USA; Cotton, Barbara J., NASA Glenn Research Center, USA; December 2001; 22p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 711-20-23

Report No.(s): NASA/TM-2001-211338; AIAA Paper 2002-0380; NAS 1.15:211338; E-13149; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Two-dimensional CFD analysis for iced airfoils can be a labor-intensive task. The software toolkit SmagIce 2D is being developed to help streamline the CFD process and provide the unique features needed for icing. When complete, it will include a combination of partially automated and fully interactive tools for all aspects of the tasks leading up to the flow analysis: geometry preparation, domain decomposition, block boundary discretization, gridding, and linking with a flow solver. It also includes tools to perform ice shape characterization, an important aid in determining the relationship between ice characteristics and their effects on aerodynamic performance. Completed tools, work-in-progress, and planned features of the software toolkit are presented here.

Author

Computational Fluid Dynamics; Ice Formation; Software Development Tools; Two Dimensional Flow

20030006759 Nevada Univ., Mechanical Engineering Dept., Reno, NV USA

High Performance Woven Mesh Heat Exchangers

Wirtz, Richard A.; Li, Chen; Park, Ji-Wook; Xu, Jun; Jul. 29, 2002; 8p; In English; See Also ADM201460. Papers from Unclassified Proceedings from the 11th Annual AAIA/MDA Technology Conference held in Monterey, CA, 29 Jul-2 Aug 2002

Contract(s)/Grant(s): F49620-99-C-0286

Report No.(s): AD-A408219; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Simple-to-fabricate woven mesh structures, consisting of bonded laminates of two-dimensional plain-weave conductive screens, or three-dimensional orthogonal weaves are described. Geometric equations show that these porous matrices can be fabricated to have a wide range of porosity and a highly anisotropic thermal conductivity vector. A mathematical model of the thermal performance of such a mesh, deployed as a heat exchange surface, is developed. Measurements of pressure drop and overall heat transfer rate are reported and used with the performance model to develop correlation equations of mesh friction factor and Colburn j-factor as a function of coolant properties, mesh characteristics and flow rate through the mesh. A heat exchanger performance analysis delineates conditions where the two mesh technologies offer superior performance.

DTIC

Laminates; Heat Exchangers

35

INSTRUMENTATION AND PHOTOGRAPHY

Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Avionics and Aircraft Instrumentation; and 19 Spacecraft Instrumentation.

20030004754 NASA Glenn Research Center, Cleveland, OH USA

Rayleigh Scattering Diagnostic for Measurement of Velocity and Density Fluctuation Spectra

Seasholtz, Richard G., NASA Glenn Research Center, USA; Panda, Jayanta, Ohio Aerospace Inst., USA; Elam, Kristie A., Akima Corp., USA; April 2002; 22p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 704-20-13

Report No.(s): NASA/TM-2002-211504; E-13270; NAS 1.15:211504; AIAA Paper 2002-0827; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A new molecular Rayleigh scattering based flow diagnostic is used for the first time to measure the power spectrum of gas density and radial velocity component in the plumes of high speed jets. The technique is based on analyzing the Rayleigh scattered light with a Fabry-Perot interferometer used in the static, imaging mode. The PC based data acquisition system is capable of simultaneous sampling of velocity and density at rates to 100 kHz and data record lengths to 10 million. Velocity and density power spectra and velocity-density cross spectra are presented for a subsonic jet, an underexpanded screeching jet, and for Mach 1.4 and

Mach 1.8 supersonic jets. Software and hardware interfaces were developed to allow computer control of all aspects of the experiment and data acquisition.

Author

Rayleigh Scattering; Velocity Measurement; Power Spectra; Fabry-Perot Interferometers; Mathematical Models

20030005593 NASA Glenn Research Center, Cleveland, OH USA

Total Internal Reflection Tomography (TIRT) for Three-Dimensional Sub-Wavelength Imaging

Fischer, David G., NASA Glenn Research Center, USA; Carney, P. Scott, Illinois Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 449-459; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

We will present a novel new form of near-field microscopy known as total internal reflection tomography (TIRT), which allows for true three-dimensional sub-wavelength imaging. It is based on recent theoretical advances regarding the fundamental interaction of light with sub-wavelength structures, as well as stable algorithms for the near-field inverse problem. We will discuss its theoretical underpinnings, as well describe current efforts at the NASA Glenn Research Center to implement a TIRT system for biofluid research.

Author

Tomography; Three Dimensional Models; Imaging Techniques; Wavelengths

20030005598 NASA Glenn Research Center, Cleveland, OH USA

Two-Photon Fluorescence Correlation Spectroscopy

Zimmerli, Gregory A., NASA Glenn Research Center, USA; Fischer, David G., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 466-473; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

We will describe a two-photon microscope currently under development at the NASA Glenn Research Center. It is composed of a Coherent Mira 900 tunable, pulsed Titanium:Sapphire laser system, an Olympus Fluoview 300 confocal scanning head, and a Leica DM IRE inverted microscope. It will be used in conjunction with a technique known as fluorescence correlation spectroscopy (FCS) to study intracellular protein dynamics. We will briefly explain the advantages of the two-photon system over a conventional confocal microscope, and provide some preliminary experimental results.

Author

Fluorescence; Photons; Spectroscopy; Microscopy; Correlation

20030005656 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Herriot Cell Augmentation of a Quadrature Heterodyne Interferometer

Antonsen, Erik L.; Burton, Rodney L.; Spanjers, Gregory G.; Engelman, Scott F.; Jun. 18, 2002; 25p; In English; Presented at the AIAA JPC held in Indianapolis, IN on 7-10 July 2002. Contains viewgraphs only

Report No.(s): AD-A408553; AFRL-PR-ED-VG-2002-152; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche
no abstract.

Author

Heterodyning; Interferometers; Quadratures

20030005689 Alabama Univ., Huntsville, AL USA

SIFTER: Scintillating Fiber Telescopes for Energetic Radiation, Gamma-Ray Applications Final Report, 8 Jun. 2000 - 30 Jun. 2002

Paciesas, William S., Alabama Univ., USA; Dec. 05, 2002; 8p; In English

Contract(s)/Grant(s): NAG5-5298; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The research project "SIFTER: Scintillating Fiber Telescopes for Energetic Radiation, Gamma-Ray Applications" approved under the NASA High Energy Astrophysics Research Program. The principal investigator of the proposal was Prof. Geoffrey N. Pendleton, who is currently on extended leave from UAH. Prof. William S. Paciasas administered the grant during Dr. Pendleton's absence. The project was originally funded for one year from 6/8/2000 to 6/7/2001. Due to conflicts with other commitments by the PI, the period of performance was extended at no additional cost until 6/30/2002. The goal of this project was to study scintillating fiber pair-tracking gamma-ray telescope configurations specifically designed to perform imaging and spectroscopy in the 5 - 250 MeV energy range. The main efforts were concentrated in two areas: 1) development of tracking techniques and

event reconstruction algorithms, with particular emphasis on angular resolution; and 2) investigation of coded apertures as a means to improve the instrument angular resolution at low energies.

Derived from text

Telescopes; Gamma Rays; Imaging Techniques; Scintillating Fibers

20030005719 Tufts Univ., Medford, MA USA

Real Time Holographic Image Processing Final Report, 1 Jul. 1995-30 Jun. 1996

Khoury, Jehad; Cronin-Golomb, Mark; Nov. 01, 1996; 76p; In English

Contract(s)/Grant(s): F30602-95-1-0026; AF Proj. 2305

Report No.(s): AD-A408111; AFRL-SN-HS-2002-042; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

We have proposed homodyne and heterodyne techniques for imaging in a scattering medium. The first technique is based on the principle of the Doppler shift difference of the light which is scattered from an object vs light scattered by the surroundings. We showed that the principle of Doppler shift difference, and the principle of first arriving light are similar. However, in contrast to first light, which requires ultrafast pulses, here modulated CW can be used. We also experimentally demonstrated the basic principle for a simple case of an object outside of the scattering medium. The second is an extension of the principle of photon density waves, using a two-dimensional (non-scanning) detection scheme.

DTIC

Image Processing; Holography; Continuous Radiation; Doppler Effect; Imaging Techniques

20030005949 California Univ., Dept. of Chemistry, Riverside, CA USA

Towards the Assembly and Characterization of Individual Molecules by Use of the Scanning Tunneling Microscope as a Nanoscopic Tool Final Report, 15 Mar. 2001-14 Sep. 2002

Bartels, Ludwig; Sep. 2002; 15p; In English; Original contains color images

Contract(s)/Grant(s): F49620-01-1-0286; AF Proj. 3484

Report No.(s): AD-A408395; AFRL-SR-AR-TR-02-0390; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This final report details the development and setup of a scanning tunneling microscope (STM) capable of operation at cryogenic temperatures in ultra-high vacuum. Main features of the instrument are rapid cooling of the sample to temperatures below 10K, low electronic and vibrational noise during operation at low temperatures and very good drift stability. These are required prerequisites for the anticipated experiments involving STM controlled molecular synthesis. Initial results are demonstrated.

DTIC

Scanning Tunneling Microscopy; Cryogenic Temperature; Electron Microscopes; Characterization; Nanotechnology

20030006323 Raytheon Co., Dallas, TX USA

New Horizons for Uncooled IR Sensors

Hanson, Charles M.; Jul. 29, 2002; 10p; In English; See Also ADM201460. Papers from Unclassified Proceedings from the 11th Annual AIAA/MDA Technology Conference held 29 July - 2 August 2002 in Monterey, CA

Report No.(s): AD-A408283; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The performance requirements for space-based IR imaging sensors are generally so severe that uncooled detector technologies have historically been ignored - and rightly so. The reasons for this have often been inaccurately represented on the basis of theoretical analysis with unnecessary assumptions. This paper shows that the performance of uncooled or minimally-cooled IR detectors can approach or even exceed that of cooled photon detectors. It also describes the practical barriers to achieving such performance. A detailed analysis of signal and noise shows that the background-limited performance of a well-designed thermal detector is not much different from that of a photon detector. The analysis also shows that these distinct detector types are optimally suited for different types of applications. The barriers to achieving background-limited sensitivity are quite different for thermal detectors. In this paper we quantify the barriers, and discuss their implications.

DTIC

Infrared Detectors; Photons

20030006681 Communications Research Lab., Japan

Lidar Instruments for Observation of the Arctic Atmosphere in Alaska-Project

Mizutani, Kohei, Communications Research Lab., Japan; Itabe, Toshikazu, Communications Research Lab., Japan; Yasui, Motoaki, Communications Research Lab., Japan; Aoki, Tetsuo, Communications Research Lab., Japan; Ishii, Shoken, Communications Research Lab., Japan; Sasano, Masahiko, Communications Research Lab., Japan; Murayama, Yasuhiro,

Communications Research Lab., Japan; Collins, Richard L., Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 165-170; In Japanese; Copyright; Avail: Issuing Activity

We developed a Rayleigh lidar system and it is now working well for temperature observations of the Arctic middle atmosphere at Poker Flat Research Range near Fairbanks, Alaska (65.1 N, 147.5W). A Rayleigh Doppler lidar for wind measurements of the middle atmosphere is in the development phase. The combination of these lidars and radars installed at Poker Flat gives us an opportunity of simultaneous observations of the structure and dynamics of the atmosphere in broad range of altitudes. We also developed a Mie lidar system (multi-wavelength lidar) to observe clouds and aerosol distribution in the arctic troposphere and stratosphere. It will be installed at Poker Flat in this year. Here, we give descriptions of the Rayleigh lidar, the Rayleigh Doppler lidar and multi-wavelength lidar for the observations of the Arctic middle atmosphere at Poker Flat.

Author

Middle Atmosphere; Optical Radar; Meteorological Radar; Doppler Radar; Temperature Measurement; Wind Measurement

20030006731 Communications Research Lab., Japan

Space-Borne Coherent Doppler Lidar

Mizutani, Kohei, Communications Research Lab., Japan; Itabe, Toshikazu, Communications Research Lab., Japan; Ishii, Shoken, Communications Research Lab., Japan; Sasano, Masahiko, Communications Research Lab., Japan; Aoki, Tetsuo, Communications Research Lab., Japan; Ohno, Yuichi, Communications Research Lab., Japan; Asai, Kazuhiro, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 45-51; In Japanese; Copyright; Avail: Issuing Activity

Global wind profiling with a space-borne Doppler lidar is expected to bring big progress in the studies on global climate modeling and accurate numerical weather prediction. This research program aims at a demonstration of the coherent Doppler lidar technology in space. CRL has been conducting feasibility study on the coherent Doppler lidar aiming at demonstration onboard the Japanese Experiment module of the International Space Station. We are in parallel developing an airborne coherent Doppler lidar system to measure wind profile under a jet plane for simulation of the Doppler lidar measurement in space. This system is also operated in the ground to develop algorithm of the wind measurements.

Author

Optical Radar; Meteorological Radar; Doppler Radar; Coherent Radar; Spacecraft Instruments

36

LASERS AND MASERS

Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also 76 Solid-State Physics.

20030005445 NASA Marshall Space Flight Center, Huntsville, AL USA

Photon Flux Amplification for Enhancing Photonic Laser Propulsive Forces

Gray, Perry A., ICRC, USA; Carruth, M. Ralph, Jr., NASA Marshall Space Flight Center, USA; Edwards, David L., NASA Marshall Space Flight Center, USA; [2002]; 8p; In English; AIAA 33rd Plasmadynamics and Lasers Conference, 20-23 May 2002, Maui, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-2177; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

An enhancement to the available force from a solar/laser sail is being investigated. This enhancement involves the use of a high power laser as the main source of propulsion or as a supplement to a solar sail. The enhancement utilizes a high power laser and multiple photon reflections to amplify the laser photon flux impinging on a sail. It is thus possible to amplify the force by as much as a factor of 50 or more. This paper explores the use of a stable optical cavity and will illustrate the optics involved in producing a stable cavity. A breadboard of the optical system was constructed and a stable cavity was demonstrated. Once the breadboard system was complete and a stable cavity achieved, the system was placed in vacuum and photon force amplification was measured using a vacuum compatible microbalance.

Author

Propulsion; Solar Sails; High Power Lasers; Photons

20030005446 NASA Marshall Space Flight Center, Huntsville, AL USA

Laser Photon Force Measurements using a CW Laser

Gray, Perry, ICRC, USA; Edwards, David L., NASA Marshall Space Flight Center, USA; Carruth, M. Ralph, Jr., NASA Marshall Space Flight Center, USA; [2002]; 8p; In English; AIAA 33rd Plasmadynamics and Lasers Conference, 20-23 May 2002, Maui, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-2178; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The photon force resulting from the non-damaging impact of laser derived photons on a metallic target was measured using a vacuum compatible microbalance. This experiment quantitatively verified that the force resulting from laser photons impacting a reflective surface is measurable and predictable. The photon wavelength is 1064 nm and the laser is a multi-mode 300W Nd YAG continuous wave (CW) laser.

Author

Laser Applications; Continuous Wave Lasers; Photons

20030005460 NASA Marshall Space Flight Center, Huntsville, AL USA

Thermophysics Characterization of Multiply Ionized Air Plasma Absorption of Laser Radiation

Wang, Ten-See, NASA Marshall Space Flight Center, USA; Rhodes, Robert, Tennessee Univ. Space Inst., USA; [2002]; 12p; In English; 33rd AIAA Plasmadynamics and Lasers Conference, 20-23 May 2002, Maui, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-2203; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The impact of multiple ionization of air plasma on the inverse Bremsstrahlung absorption of laser radiation is investigated for air breathing laser propulsion. Thermochemical properties of multiply ionized air plasma species are computed for temperatures up to 200,000 deg K, using hydrogenic approximation of the electronic partition function; and those for neutral air molecules are also updated for temperatures up to 50,000 deg K, using available literature data. Three formulas for absorption are calculated and a general formula is recommended for multiple ionization absorption calculation. The plasma composition required for absorption calculation is obtained by increasing the degree of ionization sequentially, up to quadruple ionization, with a series of thermal equilibrium computations. The calculated second ionization absorption coefficient agrees reasonably well with that of available data. The importance of multiple ionization modeling is demonstrated with the finding that area under the quadruple ionization curve of absorption is found to be twice that of single ionization. The effort of this work is beneficial to the computational plasma aerodynamics modeling of laser lightcraft performance.

Author

Radiation Absorption; Thermodynamic Equilibrium; Thermochemical Properties; Absorptivity; Ionized Gases; Laser Propulsion

20030005674 Colorado Univ., Boulder, CO USA

Stratospheric Laser Propagation Final Report, Feb. 1995-Sep. 1997

Beland, Robert R.; Oct. 2002; 4p; In English

Contract(s)/Grant(s): F19628-94-C-0137; AF Proj. ABLM

Report No.(s): AD-A408139; AFRL-VS-TR-2002-1647; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The University of Colorado simulated the evolution of the twopoint coherence function of a plane wave propagating through globally intermittent turbulence. The specific parameters of the probability-density function used were taken from stratospheric experiments. The contractor found that including the large-scale variability of the inner scale requires to carefully define the non-intermittent case. The results show that the coherence of propagation through intermittency, which is known to be strictly larger than the coherence through a medium with the average of the structure function becomes practically smaller than the coherence through the medium described by a structure function with average parameters. The phenomenon was explained theoretically.

DTIC

Optical Radar; Laser Beams; Wave Propagation; Light Transmission; Stratosphere

20030005935 Massachusetts Inst. of Tech., Cambridge, MA USA

Raman Excited Spin Coherences for Turbulence Imaging Final Report, 1 May 1998-30 Apr. 1999

Shahriar, Selim; Ezekiel, Shaoul; Apr. 1999; 13p; In English

Contract(s)/Grant(s): F30602-98-2-0016; AF Proj. 2305

Report No.(s): AD-A408358; AFRL-SN-HS-TR-2002-039; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this project was to explore the feasibility of using Raman excited spin coherence for turbulence imaging. We experimentally demonstrated that it is possible to use degenerate four-wave mixing (DFWM) in Na vapor to correct intracavity high-speed turbulence aberrations. The use of sodium vapor as a phase conjugate mirror (PCM) provides gains greater than unity and an ideal response time of about 16 nsec, even with cw laser pump beams. We demonstrated a cw degenerate phase conjugate resonator (PCR) using Na vapor with a very low lasing threshold of 4.5 W/sq cm of pump intensity. This low power threshold is produced by DFWM based on coherent population trapping (CPT) in Na vapor when operating close to the D1 transition. The intracavity turbulence was created by a He jet from a nozzle that was driven at the nozzle's resonance of 18 kHz. In the intracavity turbulence correction experiment, a typical intensity for the forward and reverse DFWM pump beams is 10W/sq cm. This experiment provided a low-threshold PCR involving a double-A CPT interaction that produced a correction factor of 9.6 for the temporal aberrations caused by an 18 kHz intracavity turbulence with a flow rate of 250 m/s.

DTIC

Turbulence; Phase Conjugation; Resonators; Raman Spectra; Spin

20030005944 Stanford Univ., Board of Trustees, Stanford, CA USA

Program of Research in Laser Oscillator Physics and Laser Device Performance Final Report, 1 Dec. 1995-31 May 1999

Siegman, A. E.; Oct. 2002; 17p; In English

Contract(s)/Grant(s): F49620-96-1-0006

Report No.(s): AD-A408388; AFRL-SR-AR-TR-02-0365; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Work has continued on laser beam analysis, laser beam characterization, and laser beam quality. Unexpected analytical and numerical result have been developed, and experimental work on the development of quasi-monolithic diode-pumped unstable resonator lasers continues. A number of papers have been published or are in course of preparation, as detailed in the report.

DTIC

Numerical Analysis; Laser Beams; Oscillators; Lasers; Resonators

20030006316 Stanford Linear Accelerator Center, Stanford, CA USA

Sensitivity of Nonlinear Harmonic Generation to Electron Beam Quality in Free-Electron Lasers

Biedron, S. G.; Huang, Z.; Kim, K.; Milton, S.; Dattoli, G.; Aug. 2002; 26p; In English

Report No.(s): DE2002-800058; SLAC-PUB-9439; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The generation of harmonics through a nonlinear mechanism driven by bunching at the fundamental has sparked interest as a path toward enhancing and extending the usefulness of an x-ray free-electron laser (FEL) facility. The sensitivity of the nonlinear harmonic generation to undulator imperfections, electron beam energy spread, peak current, and emittance is important in an evaluation of the process. Typically, linear instabilities in FELs are characterized by increased sensitivity to both electron beam and undulator quality with increasing harmonic number. However, since the nonlinear harmonic generation mechanism is driven by the growth of the fundamental, the sensitivity of the nonlinear harmonic mechanism is not expected to be significantly greater than that of the fundamental. In this paper, we study the effects of electron beam quality, more specifically, emittance, energy spread, and peak current, on the nonlinear harmonics in a 1.5-Angstrom FEL, and show that the decline in the harmonic emission roughly follows that of the fundamental.

NTIS

Free Electron Lasers; Quality Control; Particle Beams; Nonlinearity; Sensitivity; Harmonic Generations; Electron Beams

20030006680 Communications Research Lab., Japan

Airborne/Spaceborne Laser Altimeter

Ishizu, Mitsuo, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 81-95; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

Topography of the global ground surface with very high vertical accuracy and fine lateral resolution enables to observe important indicators related to the global climate change such as the decay of polar ice sheets or the growth of rain forests, and to measure land activity in agriculture and at urban areas. Satellite-borne laser altimeter is expected to measure land surface with 10cm accuracy and 100m resolution which is sufficient to observe these indicators or activities. Communications Research Laboratory has been studying this sensor as a valuable space sensor and constructed an airborne laser altimeter for the tests of an availability flying over the sea ice off the Okhotsk coasts of Hokkaido Island. This paper reports the results of this observation as well as the recent progress of our study of a satellite-borne laser altimeter.

Author

Airborne Lasers; Laser Altimeters; Satellite-Borne Instruments

MECHANICAL ENGINEERING

Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see 63 Cybernetics, Artificial Intelligence, and Robotics; and 54 Man/System Technology and Life Support.

20030005504 Massachusetts Inst. of Tech., Dept. of Mechanical Engineering, Cambridge, MA USA

Lean and Agile Precision Manufacturing Systems *Final Report*

Slocum, Alexander H.; Jan. 2002; 131p; In English

Contract(s)/Grant(s): N00014-95-1-G039

Report No.(s): AD-A408372; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

A quasi-kinematic coupling (QKC) is an alignment interface that can be used to make low-cost assemblies with sub-micron precision and/or sealing contact. Unlike kinematic couplings that rely on point contacts formed by mating balls in v-grooves, quasi-kinematic couplings are based on arc contacts formed by mating three balls with three axisymmetric grooves. Though a quasi-kinematic coupling is technically not an exact constraint coupling, proper design of the contacts can produce a weakly over constrained coupling that emulates an exact constraint coupling. This paper covers the practical design of quasi-kinematic couplings and derives the theory that predicts quasi-kinematic coupling stiffness. A metric of over constraint is presented and used to develop recommended practices for minimizing the over constraint in quasi-kinematic couplings. Experimental results are provided to show that quasi-kinematic couplings can provide repeatability (1/4 micron) that is comparable to exact constraint couplings.

DTIC

Kinematics; Manufacturing; Precision

20030006114 Ross-Hime Designs, Inc., Minneapolis, MN USA

Mechanical Design of an Omni-Directional Sensor Mount *Final Report, Jan. 1998-Jun. 2002*

Rosheim, Mark E.; Oct. 2002; 23p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-C-0014; AF Proj. 1660

Report No.(s): AD-A408440; AFRL-IF-RS-TR-2002-290; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This effort has been directed to development and demonstration of a gimbal mount capable of 180 degree singularity- free pitch and yaw motion about a two-axis center, avoiding the common problem of gimbal lock. In phase I, design of the model was completed. This report documents the transformation of the design to a fully functional device, meeting the design goals (not just the minimum acceptable performance) for a gimbal suitable for use as a mount in a satellite communication link. The gimbal has been installed in the AFRL Satellite Communication Testbed located in the Watson Laboratory of SUNY Binghamton; it will be available for remote experimentation through the NSF established internet capability at the University.

DTIC

Mechanical Engineering; Satellite Communication; Sensors; Gimbals

QUALITY ASSURANCE AND RELIABILITY

Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.

20030005514 Dayton Univ. Research Inst., Research Inst., OH USA

Improved High-Cycle Fatigue (HCF) Life Prediction *Final Report, 19 Dec. 1996-31 Dec 1999*

Gallagher, J. P.; van Stone, R. H.; deLaneville, R. E.; Gravett, P.; Bellows, R. S.; Jan. 2001; 1154p; In English; Original contains color images

Contract(s)/Grant(s): F33615-96-C-5269; Proj-4347

Report No.(s): AD-A408467; AFRL-ML-WP-TR-2001-4159; No Copyright; Avail: Defense Technical Information Center (DTIC)

An overall building block approach facilitated the development and adaptation of models for immediate application to each of the three in-service generated damage states (the foreign object damage (FOD) and fretting damage models are dependent on the low cycle fatigue / high cycle fatigue (LCF/HCF) and base-line models). The program demonstrated the overall approach for developing methods that can be adapted and integrated into engine company design practices. Approaches and models were developed to set go, no-go limits for predicting the onset of HCF- induced failures; these can be adapted and incorporated into

engine company design systems and address: threshold crack nucleation and propagation behaviors, mean stresses, multiaxial stress states, load interaction (LCF/HCF) loadings, notch shapes, FOD, and contact conditions and fretting. In addition to these overall accomplishments, a great number of individual accomplishments in the baseline and LCF/HCF areas provided synergism for generating accomplishments in the FOD and fretting damage areas.

DTIC

Fatigue (Materials); Life (Durability)

20030005805 NASA Langley Research Center, Hampton, VA USA

Optimized Vertex Method and Hybrid Reliability

Smith, Steven A., NASA Langley Research Center, USA; Krishnamurthy, T., NASA Langley Research Center, USA; Mason, B. H., NASA Langley Research Center, USA; [2002]; 12p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1465; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

A method of calculating the fuzzy response of a system is presented. This method, called the Optimized Vertex Method (OVM), is based upon the vertex method but requires considerably fewer function evaluations. The method is demonstrated by calculating the response membership function of strain-energy release rate for a bonded joint with a crack. The possibility of failure of the bonded joint was determined over a range of loads. After completing the possibilistic analysis, the possibilistic (fuzzy) membership functions were transformed to probability density functions and the probability of failure of the bonded joint was calculated. This approach is called a possibility-based hybrid reliability assessment. The possibility and probability of failure are presented and compared to a Monte Carlo Simulation (MCS) of the bonded joint.

Author

Computation; Probability Theory; Membership Functions; Loads (Forces); Failure; Bonded Joints; Vortices

20030006115 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Monitoring Damage Initiation and Evolution in Filled Polymeric Materials Using Nondestructive Testing Techniques

Liu, C. T.; Apr. 1998; 13p; In English

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408444; AFRL-PR-ED-TP-1998-072; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper reviews the efforts expended in evaluation of damage characteristics in highly filled polymeric materials under various loading conditions. Several different nondestructive testing techniques, including ultrasonic, acoustic imaging, and real-time radiography, have been used to monitor damage initiation and evolution processes. The nondestructive testing data were analyzed and the results are discussed.

DTIC

Crack Initiation; Nondestructive Tests; Ultrasonic Tests; Polymers; Mechanical Properties; Imaging Techniques

39

STRUCTURAL MECHANICS

Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.

20030004795 NASA Langley Research Center, Hampton, VA USA

A Criterion to Control Nonlinear Error in the Mixed-Mode Bending Test

Reeder, James R., NASA Langley Research Center, USA; [2002]; 23p; In English; ASTM 14th Symposium on Composite Materials: Testing and Design, 11-12 Mar. 2002, Pittsburgh, PA, USA; Sponsored by American Society for Testing and Materials, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The mixed-mode bending test has been widely used to measure delamination toughness and was recently standardized by ASTM as Standard Test Method D6671-01. This simple test is a combination of the standard Mode I (opening) test and a Mode II (sliding) test. This test uses a unidirectional composite test specimen with an artificial delamination subjected to bending loads to characterize when a delamination will extend. When the displacements become large, the linear theory used to analyze the results of the test yields errors in the calculated toughness values. The current standard places no limit on the specimen loading

and therefore test data can be created using the standard that are significantly in error. A method of limiting the error that can be incurred in the calculated toughness values is needed. In this paper, nonlinear models of the MMB test are refined. One of the nonlinear models is then used to develop a simple criterion for prescribing conditions where the nonlinear error will remain below 5%.

Author

Delaminating; Nonlinearity; Toughness; Criteria; Bending; Loads (Forces)

20030005443 James Madison Univ., Harrisonburg, VA USA

Determination of Material Properties Near the Glass Transition Temperature for an Isogrid Boom *Final Report, 15 May 2001 - 30 Apr. 2002*

Blandino, Joseph R., James Madison Univ., USA; [2002]; 11p; In English; AIAA/ASME/AHS/ASC Structures, Structural Dynamics and Materials Conference, Denver, CO, USA

Contract(s)/Grant(s): NAG1-01093

Report No.(s): AIAA Paper 2002-1334; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Experiments were performed and results obtained to determine the temperature dependence of the modulus of elasticity for a thermoplastic isogrid tube. The isogrid tube was subjected to axial tensile loads of 0-100 lbf and strain was measured at room and elevated temperatures of 100, 120, 140, 160, 180, 190, and 200 F. These were based on tube manufacturer specifying an incorrect glass transition temperature of 210 F. Two protocols were used. For the first protocol the tube was brought to temperature and a tensile test performed. The tube was allowed to cool between tests. For the second protocol the tube was ramped to the desired test temperature and held. A tensile test was performed and the tube temperature ramped to the next test temperature. The second protocol spanned the entire test range. The strain rate was constant at 0.008 in/min. Room temperature tests resulted in the determination of an average modulus of 2.34×10^6 Psi. The modulus decreased above 100 F. At 140 F the modulus had decreased by 7.26%. The two test protocols showed good agreement below 160 F. At this point the glass transition temperature had been exceeded. The two protocols were not repeated because the tube failed.

Author

Temperature Dependence; Thermoplasticity; Elastic Properties; Modulus of Elasticity; Tensile Tests; Test Ranges

20030005454 NASA Marshall Space Flight Center, Huntsville, AL USA

Characterization of Side Load Phenomena Using Measurement of Fluid/Structure Interaction

Brown, Andrew M., NASA Marshall Space Flight Center, USA; Ruf, Joseph, NASA Marshall Space Flight Center, USA; Reed, Darren, NASA Marshall Space Flight Center, USA; D'Agostino, Mark, NASA Marshall Space Flight Center, USA; Keanini, Russell, North Carolina Univ., USA; Jun. 15, 2002; 11p; In English; AIAA Joint Propulsion Conference, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

During ground-tests of most production rocket engines over the last 30 years, large asymmetric transient side loads coming from the nozzle and related steady-state vibrational loads within the nozzle have been measured. The widely varying magnitude of these loads has been large enough to fail interfacing components as well as nozzles in these engines. This paper will discuss a comprehensive test and analysis program that has been undertaken to develop a methodology to accurately predict the character and magnitude of this loading. The project to-date has incorporated analytical modeling of both the fluid flow and the nozzle structure and testing of both full-scale and sub-scale rocket nodes. Examination of the test data indicates that one of the two-nodal diameter structural modes may be interacting with flow separation from the nozzle inside-wall in a self-excited or aeroelastic vibration phenomenon. If verified, this observation will be used to develop a methodology for design and analysis. A fuller understanding of the characteristics of this vibration will provide an increase in the accuracy and confidence of side load predictions, which will be critical for the successful construction of the next generation of low-cost, reliable rocket engines.

Author

Loads (Forces); Fluid Flow; Nozzle Walls; Rocket Nozzles; Steady State; Vibrational Stress; Models

20030005487 NASA Langley Research Center, Hampton, VA USA

Postbuckling and Growth of Delaminations in Composite Plates Subjected to Axial Compression

Reeder, James R., NASA Langley Research Center, USA; Chunchu, Prasad B., Eagle Aerospace, Inc., USA; Song, Kyongchan, Swales Aerospace, USA; Ambur, Damodar R., NASA Langley Research Center, USA; [2002]; 10p; In English; 43rd AIAA/ASME/ASCE/AHS Structures, Structural Dynamics and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA;

Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations
Report No.(s): AIAA Paper 2002-1746; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The postbuckling response and growth of circular delaminations in flat and curved plates are investigated as part of a study to identify the criticality of delamination locations through the laminate thickness. The experimental results from tests on delaminated plates are compared with finite element analysis results generated using shell models. The analytical prediction of delamination growth is obtained by assessing the strain energy release rate results from the finite element model and comparing them to a mixed-mode fracture toughness failure criterion. The analytical results for onset of delamination growth compare well with experimental results generated using a 3-dimensional displacement visualization system. The record of delamination progression measured in this study has resulted in a fully 3-dimensional test case with which progressive failure models can be validated.

Author

Delaminating; Buckling; Flat Plates; Laminates; Axial Compression Loads

20030005931 Universitaet der Bundeswehr, Fachbereich Elektrotechnik, Hamburg, Germany

Longevity of Taft Joints of Superficially Mounted Construction Parts in Thermally Alternating Stress with Regard to the Significance of Elastic, Plastic and Creep Parts *Lebensdauerabschaetzung von Loetverbindungen oberflaechenmontierter Bauteile be thermischer Wechselbeanspruchung unter Beruechtigung der Bedeutung elastischer, plastischer und Kriechdehnungsanteile*

Warnke, Andreas; Jan. 1999; 166p; In German; Original contains color images

Report No.(s): AD-A408336; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The goal of this study is the refinement of the technique of low-frequency fatigue analyses of a Taft joint through computer simulation, in order to obtain, in the shortest time possible, a more precise expression of their longevity. to answer the central query, 'how long does the Taft joint hold?', there exists a series of concomitant questions, around which the study centers: on what kind of Taft joint longevity can one count; how are the Taft joint data dependent on mechanical tension, time, and temperature; which conditions promote the ideal results; what must be taken into account during the cross-linkage of the Taft joint for finite element analysis; which temperature should be chosen in order to re-portray the themocycles in a low-frequency fatigue analysis as realistically as possible; and locating the critical geometric places within the Taft joint.

DTIC

Fatigue (Materials); Joints (Junctions)

20030006107 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Fracture Parameter Calculations for SENT Specimens with Two Boundary Conditions

Baron, D. T.; Jun. 1999; 35p; In English

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408420; AFRL-PR-ED-TP-1999-0120; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Graphs and notes on the findings of fracture parameter calculations for single edge-notch tension (SENT) specimens, strained by applied uniaxial uniform load, or by applied uniaxial uniform displacement.

DTIC

Boundary Conditions; Strain Measurement; Fracture Mechanics; Tension

20030006269 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Effect of Crack Size on Growth Initiation and Propagation Behavior in a Particulate Composite Material

Liu, C. T.; Miller, T. C.; May 15, 2000; 14p; In English

Report No.(s): AD-A408509; Rept-2302; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this report is to investigate the effects of specimen thickness and initial crack length on the crack growth behavior in a particulate composite material.

DTIC

Composite Materials; Crack Propagation

20030006295 Air Force Research Lab., Space and Missile Proplision Div., Edwards AFB, CA USA

Damage Analysis for Mixed Mode Crack Initiation

Wei, Y.; Chow, C. L.; Liu, C. T.; Jun. 2000; 17p; In English; Prepared in collaboration with Univ. of Michigan-Dearborn, Dearborn, MI

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408454; AFRL-PR-ED-TP-2000-130; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The paper presents a numerical simulation for mixed mode crack initiation based on the concepts of damage mechanics. A model with two scalar damage variables is introduced for characterization of damage in a material element. Then a tangent modulus tensor is derived for damage-coupled constitutive equations. A failure criterion is developed with the concept of damage accumulation not only to identify the location of damaged element with the crack initiation angle but also to determine the critical load for mixed mode fracture. The damage model developed is incorporated in a general-purpose finite element program ABAQUA through its UMAT subroutine. The finite element program is then used to perform numerical simulation for pre-cracked specimens under monotonic tensile loading. The thin plates are made of aluminum alloy and particulate composite embedded with a crack of inclined angle $\beta = 0^\circ, 30^\circ, 45^\circ$ and 60° for mixed mode fracture analysis. The predicted crack initiation loads and the angles of crack initiation agree well with the test results.

DTIC

Finite Element Method; Cracking (Fracturing)

20030006296 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Application of Real-Time X-Ray Techniques to Monitor Damage Process in a Particulate Filled Elastomer

Liu, C. T.; Jun. 1999; 11p; In English; Pres. at Workshop on Structural Health Monitoring (2nd)

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408453; AFRL-PR-ED-TP-1999-0151; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The damage initiation and evolution processes in an edge-cracked sheet specimen subjected to a constant strain rate were investigated using real-time x-ray techniques. The specimens were made of a particulate composite material containing hard particles embedded in a rubber matrix. The x-ray data were analyzed and the results are discussed.

DTIC

Elastomers; Particulates; Real Time Operation; X Rays; Damage; Crack Initiation

20030006297 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Damage in Particulate Composites with Hard Particles Embedded in a Soft Matrix

Kwon, Y.; Liu, C. T.; Apr. 1999; 12p; In English; Presented at 12th International Conference on Composite Materials. Prepared in collaboration with Naval Postgraduate School, Monterey, CA

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408451; AFRL-PR-ED-TP-1999-0065; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Damage evolution in a particulate composite around a notch tip was studied. The composite had hard and stiff particles embedded in a soft and weak matrix like a rubber material. The major damage modes were the interface debonding called dewetting and the resulting matrix cracking because the particles were much stronger than the matrix. A numerical modeling and simulation of such damage was conducted using the micro/macro-approach. This technique combined micro-level analysis and macro-level analysis. Damage was described at the micro-level using a damage theory. Damage initiation and growth at a circular notch tip were predicted from the numerical study, and their results were compared with experimental data. Both results compared very well.

DTIC

Damage; Mathematical Models; Matrix Materials; Particulates; Crack Initiation; Notch Strength

20030006298 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Damage Study in Notched Particulate Composite Specimens Under Nonuniform Strain Loading

Kwon, Y. W.; Liu, C. T.; Aug. 1999; 7p; In English; Presented at 1999 ASME Meeting. Prepared in collaboration with Naval Postgraduate School, Monterey, CA

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408450; AFRL-PR-ED-TP-1999-0169; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper studied crack initiation in a hard particle reinforced composite with a soft rubber-like matrix material using a numerical technique. The numerical specimen considered had a semi-circular notch with a linearly varying length. The initial crack size occurring at the notch tip was modeled and predicted using a micro/macro-approach along with a damage model. A criterion to predict the initial crack size was proposed based on the size of a localized unstable material zone. Different notch sizes were compared to their initial crack sizes.

DTIC

Crack Initiation; Particulates; Strain Distribution; Composite Materials; Load Tests; Nonuniformity

20030006471 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Test Geometries for Bondline Cracked Photoelastic Models: Preliminary Results

Smith, C. W.; Gloss, K. T.; Liu, C. T.; Oct. 1999; 9p; In English; Presented at ASME 1999 Mechanical Engineering Congress and Exposition. Prepared in collaboration with Virginia Polytechnic Inst. and State Univ., Blacksburg, VA

Contract(s)/Grant(s): AF Proj. 2302

Report No.(s): AD-A408447; AFRL-PR-ED-TP-1999-0195; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

By interrogating polyurethane specimens containing bondlines with cracks photoelastically, the authors are conducting a study of the effect of fixed ends upon the stress intensity factor (SIF) for double edge cracked specimens for test specimens of relatively short height. Preliminary results suggest that, while the presence of the bondline increases the SIF with increasing crack length, reducing the specimen height will reduce the SIF level for all crack lengths.

DTIC

Photoelastic Materials; Bonded Joints; Crack Propagation; Numerical Analysis; Mechanical Properties

42

GEOSCIENCES (GENERAL)

Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see categories 41 through 48.

20030006684 Lawrence Livermore National Lab., Livermore, CA USA

Distinct Element Method - Application to Structures in Jointed Rock

Morris, J.; Glenn, L.; Blair, S.; Heuze, F.; Nov. 30, 2001; 24p; In English

Report No.(s): DE2002-802879; UCRL-JC-146404; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Distinct Element Method (DEM) is a meshfree method with applications to rock mechanics, mining sciences, simulations of nuclear repositories, and the stability of underground structures. Continuum mesh-based methods have been applied successfully to many problems in geophysics. Even if the geology includes fractures and faults, when sufficiently large length scales are considered a continuum approximation may be sufficient. However, a large class of problems exist where individual rock joints must be taken into account. This includes problems where the structures of interest have sizes comparable with the block size. In addition, it is possible that while the structure may experience loads which do no measurable damage to individual blocks, some joints may fail. This may launch smaller blocks as dangerous projectiles or even cause total failure of a tunnel. Traditional grid-based continuum approaches are wholly unsuited to this class of problem. It is possible to introduce discontinuities or slide lines into existing grid-based methods, however, such limited approaches can break down when new contacts form between blocks. The distinct element method (DEM) is an alternative, meshfree approach. The DEM can directly approximate the block structure of the jointed rock using arbitrary polyhedra. Using this approach, preexisting joints are readily incorporated into the DEM model. In addition, the method detects all new contacts between blocks resulting from relative block motion. We will describe the background of the DEM and review previous application of the DEM to geophysical problems. Finally we present preliminary results from a investigation into the stability of underground structures subjected to dynamic loading.

NTIS

Rock Mechanics; Geophysics; Mathematical Models; Simulation; Underground Structures; Fracturing

20030006702 IT Corp., Las Vegas, NV USA

Underground Test Area Project Phase I Data Analysis Task, Volume 5, Transport Parameter and Source Term Data Documentation Package

Dec. 1996; 128p; In English

Report No.(s): DE2002-800807; ITLV/10972-181-Vol-5; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Volume V of the documentation for the Phase I Data Analysis Task performed in support of the current Regional Flow Model, Transport Model, and Risk Assessment for the Nevada Test Site Underground Test Area Subproject contains the transport parameter and source term data. Because of the size and complexity of the model area, a considerable quantity of data was collected and analyzed in support of the modeling efforts. The data analysis task was consequently broken into eight subtasks, and

descriptions of each subtask's activities are contained in one of the eight volumes that comprise the Phase I Data Analysis Documentation.

NTIS

Models; Underground Structures; Test Facilities; Flow Velocity

20030006724 National Petroleum Technology Office, Tulsa, OK USA

Restored Drill Cuttings for Wetland Creation: Results of a Mesocosm Approach to Emulate Field Conditions Under Varying Salinity and Hydrologic Conditions, Volume 3

Hester, M. W.; Shaffer, G. P.; Willis, J. M.; DesRoches, D. J.; Feb. 2001; 104p; In English

Report No.(s): DE2002-774790; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

It is well documented that Louisiana has the highest rate of wetland loss in the USA. Deep-water channel dredging and leveeing of the Mississippi River since the 1930s have interrupted the natural delta cycle that builds new marshes through sediment deposition. Many of the areas that are subsiding and deteriorating are isolated from riverine sediment sources; therefore alternative methods to deposit sediment and build marshes must be implemented. This project demonstrates that the earthen materials produced when drilling oil and gas wells can be used as a suitable substrate for growing wetland plants. Drilling fluids (muds) are used to lubricate drill bits and stabilize the earth around drill holes and become commingled with the earthen cuttings. In this most recent study we examined plant performance and potential metal and ion release from processed drill cuttings under fresh, brackish, saline, and open-ocean salinity regimes. This study addressed concerns that under saline conditions ion exchange may occur that would potentially release metals and other ions from the processed drill cuttings into the interstitial water. This study also reports the response of dominant salt marsh plant species, not previously investigated, when grown on processed drill cuttings.

NTIS

Wetlands; Sediments; Drilling; Water Resources; Ion Exchanging

20030006725 National Petroleum Technology Office, Tulsa, OK USA

Restored Drill Cuttings for Wetlands Creation: Year One Results of a Mesocosm Approach to Emulate Field Conditions under Varying Hydrologic Regimes

Shaffer, G. P.; Hester, M. W.; Greene, M. C.; Childers, G. W.; Feb. 2001; 52p; In English

Report No.(s): DE2002-774789; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

During the last year, with support from the Department of Energy and Southeastern Louisiana University's college of Arts and Sciences, a state-of-the-art mesocosm facility was constructed and a program was implemented to determine the efficacy of creating wetlands with restored drill cuttings under three hydrologic regimes. Two drill cuttings processing methods were assessed along with a dredge spoil substrate (which capped the Cameron substrate) and a topsoil (control). The initial results are very interesting and are presented herein.

NTIS

Wetlands; Sediments; Drilling

43

EARTH RESOURCES AND REMOTE SENSING

Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see 35 Instrumentation and Photography.

20030004821 NASA Goddard Space Flight Center, Greenbelt, MD USA

ICESat: Ice, Cloud and Land Elevation Satellite

Zwally, Jay, NASA Goddard Space Flight Center, USA; Shuman, Christopher, NASA Goddard Space Flight Center, USA; 2002; 27p; In English; Original contains color illustrations

Report No.(s): NASA/FS-2002-9-047-GSFC; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ice exists in the natural environment in many forms. The Earth dynamic ice features shows that at high elevations and/or high latitudes, snow that falls to the ground can gradually build up to form thick consolidated ice masses called glaciers. Glaciers flow downhill under the force of gravity and can extend into areas that are too warm to support year-round snow cover. The snow line, called the equilibrium line on a glacier or ice sheet, separates the ice areas that melt on the surface and become snow free in summer

(net ablation zone) from the ice area that remain snow covered during the entire year (net accumulation zone). Snow near the surface of a glacier that is gradually being compressed into solid ice is called firm.

Derived from text

Glaciers; Ice Clouds; Land Ice; Snow Cover

20030005581 California Univ., Dept. of Chemical Engineering and Materials Science, Davis, CA USA

Mixing of Concentrated Oil-In-Water Emulsions Measured by Nuclear Magnetic Resonance Imaging (NMRI)

d'Avila, M. A., California Univ., USA; Shapley, N. C., California Univ., USA; Walton, J. H., California Univ., USA; Dungan, S. R., California Univ., USA; Phillips, R. J., California Univ., USA; Powell, R. L., California Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 352-363; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

In most emulsions, a density difference between the dispersed and the continuous phases leads to separation of the components by gravity, known as "creaming." Typically, a uniform emulsion is desirable, and hence it is important to examine the kinetics and mechanism of emulsion mixing required to achieve this uniform state. In addition, previous mixing research has focused on the impact of known flow fields on the microstructure of the system, where the microstructures do not modify the flow field in the process. In contrast, in the case of concentrated emulsions, it is shown here that the evolution of the nonuniform droplet concentration profile has a major impact on the observed flow field. Mixing of concentrated oil-in-water emulsions in a horizontal, concentric-cylinder geometry was studied using nuclear magnetic resonance imaging (NMRI). The NMRI technique provides droplet concentration and velocity profiles noninvasively and in situ within a flowing, concentrated emulsion of isooctane and water stabilized with nonionic surfactant. An initial nonuniform concentration profile is established by creaming of a homogeneous emulsion. We then measure the time-dependent effect of slow shear flow on the concentration and velocity profiles. Time-of-flight and chemical shift imaging methods were used to measure velocity profiles and concentration maps during the mixing process, respectively. The results obtained show detailed information about the mixing process in concentrated emulsions. It was found that the thickness of the cream layer remains constant during mixing while the concentration in that layer decays exponentially as a function of time. It was also observed that while mixing occurs, most of the emulsion is quiescent, the only detectable motion being in a thin moving layer close to the rotating outer cylinder wall. A simple model is introduced that is able to give a reasonable explanation of these experimental observations. These results indicate that the mixing mechanism and kinetics in concentrated emulsions are significantly different from those in single-phase liquids.

Author

Nuclear Magnetic Resonance; Imaging Techniques; Flow Distribution; Chemical Equilibrium; Gravitation

20030005586 Johns Hopkins Univ., Baltimore, MD USA

Using Surfactants to Control Bubble Growth and Coalescence

Stebe, Kathleen J., Johns Hopkins Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 393-407; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

The effects of surfactant adsorption on bubble formation at an orifice are studied numerically at finite Reynolds number. Establishing the hydrodynamics and mass transfer during bubble growth and detachment will improve insight into the nucleate boiling process and aid in developing paradigms for enhancement of the heat transfer coefficient during nucleate boiling. The volume-of-fluid method is employed to solve the two-dimensional axisymmetric Navier-Stokes equations. The interface is tracked using marker points that accurately represent the surface tension forces at the interface. The evolution and detachment of the bubble is examined as a function of the capillary and Bond numbers. At low surface tension, strong deformations of the interface are observed leading to bubbles that assume a mushroom shape. Surfactants change the surface tension according to a non-linear equation of state that takes into account maximum packing at the interface. A variety of behaviors are predicted, depending upon the ratio of the convection rate to the prevailing mass transfer rates. In particular, if these rates are comparable, regions of local surfactant accumulation develop where the surfactant concentration approaches its upper bound, causing the local surface tension to reduce strongly and rendering the interface highly deformable.

Author

Surfactants; Bubbles; Coalescing; Adsorption

20030005587 Jet Propulsion Lab., California Inst. of Tech., Pasadena, CA USA

Supercritical and Transcritical Shear Flows in Microgravity: Experiments and Direct Numerical Simulations

Talley, Doug, Air Force Research Lab., USA; Bellan, Josette, NASA Glenn Research Center, USA; Chehrودي, Bruce,

Engineering Research and Consulting, Inc., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 408-409; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

The objective of this research, which began in April 2002, is to develop and experimentally validate a near-critical transcritical and supercritical fluid shear flow model independent of turbulence. We define a supercritical shear flow to be one in which all of the fluid particles remain above their critical temperature and pressure. We define a transcritical shear flow to be one in which at least some of the fluid particles undergo a transition between a subcritical and a supercritical temperature, between a subcritical and a supercritical pressure, or both. The reason it is necessary to validate the fluid model independent of turbulence is that turbulence introduces a large number of additional mechanisms the understanding of which is embryonic at best for near-critical transcritical and supercritical flows. Validating the fluid model without turbulence uncertainties therefore requires laminar flows. However, laminar flows that are not influenced by gravity are difficult to produce in normal gravity due to the large density gradients involved. Therefore, microgravity experiments are necessary. The co-investigators have considerable experience modeling supercritical mixing and shear layers (JPL), and considerable experience in performing transcritical and supercritical droplet and jet experiments in normal gravity (AFRL/ERC). This experience will be applied to perform a microgravity experiment where the results can be directly compared with direct numerical simulations. An entry into the related publications of the co-investigators can be found.

Author

Numerical Analysis; Fluid Flow; Gravitational Effects; Laminar Flow; Shear Flow; Supercritical Fluids

20030005588 California Univ., Center for Risk Studies and Safety, Santa Barbara, CA USA

The Scales Separation Phenomenon in High Heat Flux Pool Boiling

Theofanous, T. G., California Univ., USA; Li, G. J., California Univ., USA; Tu, J. P., California Univ., USA; Dinh, T. N., California Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 410-419; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A02, Hardcopy; A06, Microfiche

This is the first progress report on a recently-initiated research project aiming to a basic understanding of Boiling Crisis in forced convection boiling. The work is a continuation and extension of a project that addressed coolability limits in pool boiling carried out over the previous funding cycle. A key result of this previous work was the identification of a scales separation phenomenon, that effectively "isolates" the microhydrodynamics on the heater surface from the chaotic two-phase flow motions away from it. This separation is effected by a persistent very high void fraction region (like a vapor "blanket"), and it is of immense significance in allowing to focus the physics of a long-standing apparently intractable problem. We expect that such a separation of scales would be present also in convective boiling, especially in the low flow rates regimes that are of interest in space applications, so the subject is pursued as a key component of the present effort as well. In this report we describe our efforts towards a more precise and detailed characterization as needed to elucidate the key mechanisms for both pool and convective boiling geometries. The region of interest extends from outside the microlayer, undulating on the heater surface (10s of microns), up to a few millimeters away from it. This requires high spatial resolution in the vertical dimension over the whole horizontal macroscopic dimension needed to reveal the pattern (the whole 2.5 cm x 4 cm surface area of the heater), and obviously the measurement must be non-intrusive. Our previous work demonstrated the value and potential of the X-ray radiography technique for this purpose. The point of departure here is consideration of scattered X-rays, associated improvements to our test section and radiography imaging techniques including positioning, collimating, and film/intensifier choice and development. Further, the work included extensive calibrations, especially using "ghosts" of known and similar (but static) material configurations. of special importance was the replacement of the glass wall of our test section by pieces made of KAPTON material. Sample results are shown. The radiographs depict projections over the narrow dimension of the test section (2.6 mm) and the gray scales show local (in 2D, heights-width) void fraction distributions and their variation with heat flux. Ensemble averages can be constructed from such images taken repeatedly. The line diagram shows the results of horizontal averaging of these radiographs --- that is, area averages over horizontal planes as function of their distance from the heater. The high void fraction region is seen to be well established at heat flux levels over approx. 700 kW/sq m. Closer examination can reveal further details on the internal structures of this important region.

Author

Boiling; Convection; Flow Velocity; Heat Flux; Nonintrusive Measurement; Two Phase Flow; Separation

20030005589 California Univ., Center for Risk Studies and Safety, Santa Barbara, CA USA

Nucleation on Nanoscopically Smooth Surfaces

Theofanous, T. G., California Univ., USA; Tu, J. P., California Univ., USA; Dinh, T. N., California Univ., USA; Sixth Microgravity

Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 420-431; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

This is the first progress report on a recently-initiated research project aiming to a basic understanding and prediction of the Boiling Crisis phenomenon in convective boiling. The work is a continuation and extension of a project that addressed coolability limits in pool boiling and was carried out over the previous funding cycle. A key ingredient of our approach is the use of high speed, high resolution infrared imaging in conjunction with nanofilm (in thickness) heaters of macroscopic dimensions to detect the evolution of thermal patterns at the solid-fluid interface. In particular the configuration allows the detection of bubble nucleation events, and it has permitted the first direct determination of bubble nucleation densities in high heat flux boiling. This work established a strong connection of the surface nucleation characteristics and it's resistance to burnout, so nucleation is pursued as a key component of the present effort on convective boiling as well. The point of departure is a further finding of this work that nucleation on nanoscopically smooth (± 4 nm rms roughness) surfaces is not consistent with the apparently (and firmly) established preexisting cavity nucleation theory (PEN) as propounded by Zeldovich (1943), Dean (1944), and Bankoff (1958), and elaborated more recently by Wang and Dhir (1993). More specifically our work points to surface nanomorphology and chemistry at the origin of heterogeneous nucleation, thus leading us to question whether there is any role left to "roughness" (as conceived in PEN), even for rough, engineering surfaces. Thus, in this nucleation-focus portion of our project, the domain of interest includes all kinds of surfaces, rough and "dirty" ones as found in traditional engineering equipment, as well as ultrasmooth and "clean" ones as found in new micro scale technologies such as cooling of microelectronic equipment, and operation of micro fluidic devices. In this report we present the results of our first steps in addressing the potential role of "roughness". The idea is that this role can be isolated by using nanofilms on preroughened glass substrates. Using precision sandblasting we can create micron-scale roughnesses that resemble those of common engineering surfaces. On the other hand, using metal vapor deposition techniques, we can build films (on these substrates) with chemistries and nanomorphologies precisely similar to those found on our smooth nanofilms of our previous work. All other aspects of the experimental apparatus and diagnostics are also the same. Experiments are conducted either on a pulse-heating mode, where a significant change in heat flux is instantaneously imposed, or in a steady-state mode, where heating is changed by small increments (or decrements). The gray scales are in degree centigrade.

Author

Nucleation; Surface Roughness; Boiling; Convection; Coolers; Burnout; Cavities

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ENERGY PRODUCTION AND CONVERSION

Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.

20030005735 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Solar Rocket Propulsion. Ground and Space Technology Demonstration

Holmes, Michael; Mar. 29, 2001; 14p; In English

Contract(s)/Grant(s): AF Proj. 1011

Report No.(s): AD-A408537; AFRL-PR-ED-VG-2001-071; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

No abstract.

Author

Solar Heating; Solar Propulsion; Aerospace Engineering

20030005761 Phillips Lab., Edwards AFB, CA USA

One Dimensional Model of a Solar-Thermal Thruster Using a Porous Absorber/ Heat Exchanger

Holmes, Michael R.; Oct. 15, 1993; 30p; In English

Report No.(s): AD-A408428; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a one dimensional model of a solar-thermal thruster using a porous disk as a concentrated sunlight absorber and heat exchanger. This type of thruster is one of several high Isp thruster concepts being studied by the Phillips Laboratory to transfer payloads from low earth orbit to geosynchronous orbit. Soar propulsive techniques should deliver close to 1000 sec of Isp using a very low molecular weight propellant, hydrogen. The purpose of this model is to determine the

dependency of thrust, specific impulse, and energy conversion efficiency upon a variety of parameters including solar concentration, and propellant mass flow rate.

DTIC

Heat Exchangers; Porosity; Rocket Thrust; Propulsion System Performance; Mathematical Models; Absorbers (Materials)

20030006694 Wyoming Univ., Western Research Inst., Laramie, WY USA

Providing Solutions to Energy and Environmental Problems *Quarterly Report*

Jul. 1998; 38p; In English

Report No.(s): DE2002-778914; WRI-98-R032; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The report gives updates on the following projects - for the time frame of April 1, 1998 through June 30, 1998. WRI Support for Commercialization of the Koppelman Series C Process; Contained Recovery of Oily Wastes (CROW (Trademark)) Field Demonstration with Bell Lumber and Pole; Solid State NMR Analysis of Mowry Formation Shale from Different Sedimentary Basins; Field Testing of the TaBoRR Process Using the Asphalt and Dry Bottoms Configurations; Market Assessment and Demonstration of Lignite FBC Ash Flowable Fill Applications; Fiddler Creek Polymer Augmentation Project; The Development of Synthetic Soil Materials for the Successful Reclamation of Abandoned Mined Land Sites; and Synthetic Soil Materials for Reclamation of Abandoned Mine Sites.

NTIS

Research Projects; Fossil Fuels; Nuclear Magnetic Resonance; Market Research; Field Tests

20030006696 Wyoming Univ., Western Research Inst., Laramie, WY USA

Base Program on Energy Related Research *Quarterly Report, April - July 1998*

Jul. 1998; 32p; In English

Report No.(s): DE2002-778907; WRI-98-R033; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Base Research Program at Western Research Institute (WRI) is planned to develop technologies to a level that will attract industrial sponsors for continued development under the Jointly Sponsored Research (JSR) Program. The Base Cooperative Agreement (DE-FC26-98FT40322) was initiated on April 10, with funding of \$500,000. Tasks approved for funding, FY 98 include the following: 1.1 CROW Process Application for Sites Contaminated With LNAPL and Chlorinated Solvents -\$50,000; 1.2 Petroleum residual Solubility Parameter/Polarity Map-\$75,000; 1.3 Laboratory and Bench-Scale Testing for Treating Used Motor Oil-\$135,000; 1.4 Development and Testing of a Coal-Fired Gas Turbine System- \$140,000; 2.1 Evaluation of a Method Using Colloidal Gas Aphrons to Remediate Metals-Contaminated Mine Drainage Waters-\$15,000; 2.2 Development of a Procedure for Production of a Protective Covering for PEAC Units - \$15,000; and 3.1 Heavy Oil/Plastics Co-Processing -\$70,000
TOTALS-\$500,000

NTIS

Research Projects; Technology Transfer; Contamination; Solvents

20030006697 North Dakota Univ., Energy and Environmental Research Center, Grand Forks, ND USA

JSRP Task 1-Air Quality: Mercury, Trace Elements and Particulate Matter Conference *Final Report*

Pavlish, J. H.; Benson, S. A.; Jul. 1999; In English, 14 Dec. 1998, McLean, VA, USA

Report No.(s): DE2002-778904; Rept-99-EERC-07-07; No Copyright; Avail: National Technical Information Service (NTIS)

This final report summarizes the planning/preparation, facilitation, and outcome of the conference entitled Air Quality: Mercury, Trace Elements, and Particulate Matter that was held December 14, 1998, in McLean, Virginia (on the outskirts of Washington, DC). The goal of the conference was to bring together industry, government, and the research community to discuss the critical issue of how air quality can impact human health and the ecosystem, specifically hazardous air pollutants and fine airborne particles; available and developing control technologies; strategies and research needs; and an update on federal and state policy and regulations, related implementation issues, and the framework of the future.

NTIS

Air Pollution; Mercury (Metal); Particulates; Air Quality; Health; Trace Elements

20030006698 Federal Energy Technology Center, Pittsburgh, PA USA

Removal of Organic Pollutants from Subcritical Water with Activated Carbon

Hawthorne, S. B.; Lagadec, A. J.; Aug. 1999; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-778429; Rept-99-EERC-08-02; No Copyright; Avail: National Technical Information Service (NTIS)

This project will determine the important controlling parameters for using activated carbon for cleaning subcritical water. Water temperature, carbon type, and the relative importance of elution versus retention will be determined by elution tests with a variety of pollutants (e.g., PACS, PCBs, and/or pesticides). Studies will be performed with standard mixes and with subcritical water extracts of real contaminated soils.

NTIS

Activated Carbon; Soil Pollution; Contaminants; Organic Chemistry

20030006701 Sandia National Labs., Albuquerque, NM USA

Blending Study of MgO-Based Separator Materials for Thermal Batteries

Guidotti, R. A.; Reinhardt, F. W.; Andazola, A. H.; Jun. 2002; 58p; In English

Report No.(s): DE2002-800973; SAND2002-1458; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The development and testing of a new technique for blending of electrolyte-binder (separator) mixes for use in thermal batteries is described. The original method of blending such materials at Sandia involved liquid Freon TF' as a medium. The ban on the use of halogenated solvents throughout much of the Department of Energy complex required the development of an alternative liquid medium as a replacement. The use of liquid nitrogen (LN) was explored and developed into a viable quality process. For comparison, a limited number of dry-blending tests were also conducted using a Turbula mixer. The characterization of pellets made from LN-blended separators involved deformation properties at 530 deg.C and electrolyte-leakage behavior at 400 deg or 500 deg C, as well as performance in single-cells and five-cell batteries under several loads. Stack-relaxation tests were also conducted using 10-cell batteries. One objective of this work was to observe if correlations could be obtained between the mechanical properties of the separators and the performance in single cells and batteries.

NTIS

Thermal Batteries; Magnesium Oxides; Separators; Mixtures

20030006703 Sandia National Labs., Albuquerque, NM USA

Building, Testing, and Post Test Analysis of Durability Heat Pipe Number 6

Moss, T. A.; Mar. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800788; SAND2002-0730; No Copyright; Avail: National Technical Information Service (NTIS)

The Solar Thermal Program at Sandia supports work developing dish/Stirling systems to convert solar energy into electricity. Heat pipe technology is ideal for transferring the energy of concentrated sunlight from the parabolic dish concentrators to the Stirling engine heat tubes. This report covers the building, testing, and post-test analysis of the sixth in a series of bench scale heat pipes. Durability heat pipe no. 6 was built and tested to determine the effects of a high temperature bakeout, 950 C, on wick corrosion during long-term operation. Previous tests showed high levels of corrosion with low temperature bakeouts (650-700 C). Durability heat pipe no. 5 had a high temperature bakeout and reflux cleaning and showed low levels of wick corrosion after long-term operation. After testing durability heat pipe no. 6 for 5,003 hours at an operating temperature of 750 C, it showed low levels of wick corrosion. This test shows a high temperature bakeout alone will significantly reduce wick corrosion without the need for costly and time consuming reflux cleaning.

NTIS

Heat Pipes; Durability; Solar Energy; Temperature Effects

20030006704 Sandia National Labs., Albuquerque, NM USA

Receiver System: Lessons Learned from Solar Two

Litwin, R. Z.; Mar. 2002; 46p; In English

Report No.(s): DE2002-800776; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Boeing Company fabricated the Solar Two receiver as a subcontractor for the Solar Two project. The receiver absorbed sunlight reflected from the heliostat field. A molten-nitrate-salt heat transfer fluid was pumped from a storage tank at grade level, heated from 290 to 565DGC by the receiver mounted on top of a tower, then flowed back down into another storage tank. to make electricity, the hot salt was pumped through a steam generator to produce steam that powered a conventional Rankine steam turbine/generator. This evaluation identifies the most significant Solar Two receiver system lessons learned from the Mechanical Design, Instrumentation and Control, Panel Fabrication, Site Construction, Receiver System Operation, and Management from the perspective of the receiver designer/manufacture. The lessons learned on the receiver system described here consist of two

parts: the Problem and one or more identified Solutions. The appendix summarizes an inspection of the advanced receiver panel developed by Boeing that was installed and operated in the Solar Two receiver.

NTIS

Evaluation; Solar Collectors; Control Boards; Receivers; Fabrication

20030006722 Westinghouse Electric Corp., Advanced Systems Technology Div., East Pittsburgh, PA USA

Development of analytical Methods for the Quantification of the Chemical Forms of Mercury and Other Target Pollutants in Coal-Fired Boiler Flue Gas *Final Report*

McManus, T. J.; Jun. 30, 1999; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-778029; No Copyright; Avail: National Technical Information Service (NTIS)

Contents include the following: Background, Goals and summary of results; Mercury methods: Laboratory development work; (Mercury Methods-Sampling Trains, General Experimental: Equipment, Reagents and Procedures, Reagents and Equipment, Preliminary Impinger Spiking Studies: EPA Method 101A, Impinger Spiking Studies: EPA Method 29 and the Ontario-Hydro Method, Comparative Multi-Laboratory Spiking Study: EPA Method 29 and the Ontario-Hydro Method, ATS/UNDEERC Laboratories Joint Spiking Study: EPA Method 29 and the Ontario-Hydro Technologies Method, Minimization of the Effects of Sulfur Dioxide Present in Flue Gas); Mercury methods: Pilot-scale sampling studies (General Experimental: Facilities and Methodologies, Description of FETC Pilot Plant, General EPA Stack Sampling Procedures, Particulate Matter (PM) and Multi-Metals Sampling Procedures, Presentation of Data, Sample Handling. Quality Control/Quality Assurance, DOE/FETC Study I, DOE/FETC Study II, ABB Study, Background and Objectives, Results and Discussions, Conclusions). Calibration of a Mercury Injection System for a Pilot-Scale Coal Combustion Unit, Volatile organic compounds (VOCs) field sampling study, References.

NTIS

Boilers; Chemical Analysis; Contaminants; Coal; Mercury (Metal); Flue Gases; Amount

20030006726 Stamet, Inc., Gardena, CA USA

Proof of Principal Test to Feed and Meter Granular Coal into 450 psig Gas Pressure *Quarterly Report*

Aldred, D. L.; Apr. 1999; 18p; In English

Report No.(s): DE2002-778915; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The objective of this project is to demonstrate proof of principal to feed and meter granular coal into 450 psig gas pressure for use with pressurized fluidized bed combustors. This report summarizes work undertaken in the first quarter of 1999 in support of that objective. Materials testers have been designed and built to assess properties relevant to performance in the Stamet pump. Testing has been carried out to evaluate these properties for materials to be pumped. A small scale pump has been modified and preliminary testing has been carried out to assess the effectiveness of the sealing and venting modifications, and the effect of outlet material sealing plug length on required HP and gas leakage. The sealing and venting modifications worked well, and measurements of gas leakage and power requirements were in line with predictions made from the measured materials properties and pump geometry. Changes to the large scale pump test rig to upgrade to the necessary 450 psig pressure rating have been defined and components ordered. The data from the materials and small scale pump testing is being used to define the necessary changes to the large scale SBIR test pump to reach the 450psig target.

NTIS

Coal; Combustion Chambers; Gas Pressure; Sealing

45

ENVIRONMENT POLLUTION

Includes atmospheric, water, soil, noise, and thermal pollution.

20030005479 NASA Glenn Research Center, Cleveland, OH USA

Setting up a Rayleigh Scattering Based Flow Measuring System in a Large Nozzle Testing Facility

Panda, Jayanta, Ohio Aerospace Inst., USA; Gomez, Carlos R., NASA Glenn Research Center, USA; November 2002; 14p; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 708-90-43

Report No.(s): NASA/TM-2002-211985; NAS 1.15:211985; E-13655; AIAA Paper 2003-1089; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A molecular Rayleigh scattering based air density measurement system has been built in a large nozzle testing facility at NASA Glenn Research Center. The technique depends on the light scattering by gas molecules present in air; no artificial seeding is required. Light from a single mode, continuous wave laser was transmitted to the nozzle facility by optical fiber, and light scattered by gas molecules, at various points along the laser beam, is collected and measured by photon-counting electronics. By placing the laser beam and collection optics on synchronized traversing units, the point measurement technique is made effective for surveying density variation over a cross-section of the nozzle plume. Various difficulties associated with dust particles, stray light, high noise level and vibration are discussed. Finally, a limited amount of data from an underexpanded jet are presented and compared with expected variations to validate the technique.

Author

Rayleigh Scattering; Density Measurement; Continuous Wave Lasers; Light Scattering

20030005675 Woods Hole Oceanographic Inst., MA USA

Anticipating Sediment Bed-to-Water Column Exchanges of Toxic Organic Compounds in Naval Harbors *Final Report, 1 Oct. 1998-31 Mar. 2002*

Geyer, W. R.; Gschwend, Philip M.; Oct. 22, 2002; 13p; In English; Original contains color images

Contract(s)/Grant(s): N00014-99-1-0039

Report No.(s): AD-A408137; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study explored the importance of sediment resuspension on the distribution of hydrophobic organic contaminants (HOCs) in urban estuaries. The study consisted of three components: 1) a passive, in situ sampler, the polyethylene device (PED) was developed and tested; 2) the desorption rate of pyrene, a polycyclic aromatic hydrocarbon (PAH), was quantified from native Hudson River sediments; and 3) a field study was conducted to quantify the influence of sediment resuspension in the lower Hudson estuary on the distributions of pyrene and PCB #52.

DTIC

Toxic Hazards; Organic Compounds; Harbors; Sediments; Contaminants

20030005928 Army Engineer Research and Development Center, Environmental Lab., Vicksburg, MS USA

Vapor-Phase Transport of Explosives Compounds in Soils *Final Report*

Ravikrishna, R.; Yost, Sally L.; Price, Cynthia B.; Hayes, Charolett A.; Valsaraj, Kalliat T.; Sep. 2002; 66p; In English; Original contains color images; --Original contains color plates: All DTIC reproductions will be in black and white. Prepared in cooperation with Louisiana State University Department of Chemical Engineering

Report No.(s): AD-A408324; ERDC/EL TR-02-26; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The fate and transport of explosives in the air-filled pores within soil affect both the potential detection of buried ordnance by chemical sensors and vadose zone transport of explosives residues. The efficacy of chemical sensors and their potential usefulness for detecting buried unexploded ordnance (UXO) is difficult to determine without understanding how explosives chemical signatures are transported through soil. The objectives of this study were to quantify chemical signature transport through soils under various environmental conditions in unsaturated soils and to develop a model for chemical signature transport in unsaturated soils. Flux chambers, large soil containers, and batch testing were used to determine explosives signature movement and process descriptors for model development. This study showed that the moisture content and temperature of soils affect the flux of explosives chemical signatures from soils. Low signatures were observed for explosives under all environmental conditions. Low fluxes of even the most volatile compounds from explosives indicate that this environmental loss pathway is minimal. A model was developed that can accurately predict explosives signature movement to the surface where chemical detection can occur when the source strength is known. The model can also predict explosives signature movement and corresponding accumulation of explosives concentrations in vadose zone soils. Chemical sensors will need to be very sensitive because of low signatures. However, this may result in many false alarms because of explosives residues not associated with UXO on firing ranges. Low explosives signatures should also result in insignificant air environmental exposures.

DTIC

Ordnance; Explosives; Detection; Soils

20030005951 Battelle Columbus Labs., OH USA

A Pilot-Scale Evaluation of Polychlorinated Biphenyl Bioremediation Technologies at Cape Canaveral Air Station, Florida Final Report

Morse, Jeff J.; Sep. 27, 2000; 129p; In English; Original contains color images

Report No.(s): AD-A408398; No Copyright; Avail: Defense Technical Information Center (DTIC)

Polychlorinated biphenyls (PCBs) are a group of chemicals possessing chemical properties that make them attractive for use in a wide variety of industrial applications. Their widespread use has led to their introduction into the environment. The Air Force has a number of sites that are contaminated with PCBs. This contamination has typically resulted from leaks and spills of electrical transformer cooling with that contained PCBs. The potential harm posed to human health and the environment has prompted the USA Environmental Protection Agency (U.S. EPA) and state regulatory authorities to set maximum allowable PCB concentrations at a site.

DTIC

Polychlorinated Biphenyls; Contamination; Chemical Properties; Environment Protection

20030006321 Air Force Research Lab., Materials and Manufacturing Directorate, Tyndall AFB, FL USA

Evaluation of Volatile Organic Compound Emission from the Preparation and Application of BoeGel-EP-II Final Report, Jan. 1999-Aug. 2000

Henley, M. V.; Weber, R. M.; Wyatt, S. E.; Jan. 2002; 6p; In English; Prepared in collaboration with Applied Research Assoc., Tyndall AFB, FL

Contract(s)/Grant(s): F08637-98-C-6002

Report No.(s): AD-A408286; AFRL-ML-TY-2002-4609; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Efforts to reduce ground-level ozone production resulting from Department of Defense (DoD) operations often involve the substitution of materials with lower volatile organic compound (VOC) concentrations. VOCs are known to react in the atmosphere and lead to the production of ozone, a regulated pollutant. However, the amount of ozone produced varies with each individual VOC and with the concentration of nitric oxides (NO_x) present in the airshed. To better assess the air quality impact of a VOC, it is necessary to know its atmospheric chemistry mechanisms. That is to say, what are its kinetic rate constants with reactive species in the atmosphere and what are its transformation pathways? Transformation pathways are important since products of reaction may also contribute to ozone production. A thorough characterization of a formulation's emission profile coupled with VOC ozone-forming potential (incremental reactivity) provides a means of assessing the product's air-quality impact. This report characterizes the VOC emissions from the preparation (mixing) and application of a sol-gel surface preparation formulation obtained from The Boeing Co. and designated as BoeGel-EP II.

DTIC

Emission; Ozone; Nitrogen Oxides; Contaminants; Atmospheric Composition

20030006661 Communications Research Lab., Japan

Balloon-Borne Superconducting Submillimeter-Wave Limb-Emission Sounder for Observations of Middle Atmosphere

Irimajiri, Yoshihisa, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 21-36; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

Recently, ozone destruction and global warming become serious problems. We are developing a balloon-borne superconducting submillimeter-wave limb-emission sounder (BSMILES) with a superconducting (SIS) receiver at 650-GHz band for observations of stratospheric ozone and other minor constituents that play important roles for ozone depletion. The sounder will be launched at Sanriku in 2003.

Author

SIS (Superconductors); Sounding; Middle Atmosphere; Submillimeter Waves; Radio Receivers; Meteorological Balloons

20030006666 Communications Research Lab., Japan

CRL Alaska Project: International Collaborations for Observing Arctic Atmosphere Environment in Alaska

Murayama, Yasuhiro, Communications Research Lab., Japan; Mori, Hirotaka, Communications Research Lab., Japan; Ishii, Mamoru, Communications Research Lab., Japan; Kubota, Minoru, Communications Research Lab., Japan; Oyama, Shin-Ichiro, Communications Research Lab., Japan; Yamamoto, Masa-Yuki, Communications Research Lab., Japan; Seki, Kouji, Communications Research Lab., Japan; Mizutani, Kohei, Communications Research Lab., Japan; Ochiai, Satoshi, Communications Research Lab., Japan; Kikuchi, Takashi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 127-135; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

In this paper we briefly overview the CRL Alaska Project, which is to develop advanced radio/optical remote-sensing technologies and to construct a comprehensive observation system of Arctic middle atmosphere, in cooperation with US and Japanese institutions including the most major partner of Geophysical Institute of University of Alaska. The observation system is to demonstrate the technologies and also to study Arctic atmosphere changes and variations in relation to Global Change and solar activity effects. Eight instruments out of nine, which are components of the observation system, have started experiments in Alaska in recent years. A data network system named SALMON (System for Alaska Middle atmosphere Observation data Network) is also being developed to automatically transfer and process the observed data employing broadband international network experiments APAN and TransPAC, from Alaska through Japan for WEB displays open to the world.

Author

Arctic Regions; Alaska; Remote Sensing; Middle Atmosphere

20030006673 Communications Research Lab., Japan

Development of SALMON System and the Environment Data Transfer Experiment

Oyama, Shin-Ichiro, Communications Research Lab., Japan; Murayama, Yasuhiro, Communications Research Lab., Japan; Ishii, Mamoru, Communications Research Lab., Japan; Kubota, Minoru, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 229-233; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

We develop SALMON (System for Alaska Middle Atmosphere Observation Data Network) at Communications Research Laboratory for the network technology and development to smoothly deliver measured environment data, which is very important to study global environment issues. This system is developed using environment data measured at Alaska and the high-speed computer network of APAN and TransPAC. This paper shows the SALMON system structure and shows results from the data transfer experiment using the SALMON system together with development elements for the environment data transfer technology.

Author

Computer Networks; Middle Atmosphere; Data Transfer (Computers)

20030006674 Communications Research Lab., Japan

Development of Collaboration System for Environmental Study

Aoki, Tetsuo, Communications Research Lab., Japan; Mizutani, Kohei, Communications Research Lab., Japan; Itabe, Toshikazu, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 235-239; In Japanese; Copyright; Avail: Issuing Activity

It is very important to collect various data in various places in the global environment study, which is one typical field requiring synthetic effort among various scientific disciplines. It is also important to carry out close collaboration with researchers in many research fields. We are developing a system realizing new concept, which enables us to share observation equipments, database, knowledge, etc., and thereby realizes a so-called multimedia virtual laboratory (MVL). In addition, the concept of MVL does not only mean in mere research and development activities, but also extensive applications in education, medicine, various telecommunications, is expected.

Author

Cooperation; Multimedia; Research; Information Systems

20030006682 Communications Research Lab., Japan

Trace Gas Observation with Poker Flat FTIR

Seki, Kouji, Communications Research Lab., Japan; Kasai, Yasuko, Communications Research Lab., Japan; Murayama, Yasuhiro, Communications Research Lab., Japan; Mizutani, Kohei, Communications Research Lab., Japan; Itabe, Toshikazu, Communications Research Lab., Japan; Murcray, Frank J., Communications Research Lab., Japan; Simpson, William R., Communications Research Lab., Japan; Lloyd, Steven A., Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 171-179; In Japanese; Copyright; Avail: Issuing Activity

We have been observing atmospheric trace gases using Fourier transform infrared spectrometer (FTIR), which was installed at Poker Flat observation site, Alaska (65.07 N, 147.26 W) since July 1999. FTIR has often been used to derive the total column amount of trace gas from its intensity of the absorption spectrum. In this paper, we have derived height profile of ozone

concentration from line shape of the absorption spectrum of ozone using a retrieval method. We explain the scheme of the retrieval method we used and the comparison between our results retrieved and those obtained from other instruments.

Author

Atmospheric Composition; Fourier Transformation; Infrared Spectroscopy; Ozone

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GEOPHYSICS

Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see 47 Meteorology and Climatology; and 93 Space Radiation.

20030005599 NASA Glenn Research Center, Cleveland, OH USA

Effect of Gravity on the Near Field Flow Structure of Helium Jet in Air

Agrawal, Ajay K., Oklahoma Univ., USA; Parthasarathy, Ramkumar, Oklahoma Univ., USA; Griffin, DeVon, NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 475-486; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Experiments have shown that a low-density jet injected into a high-density surrounding medium undergoes periodic oscillations in the near field. Although the flow oscillations in these jets at Richardson numbers about unity are attributed to the buoyancy, the direct physical evidence has not been acquired in the experiments. If the instability were indeed caused by buoyancy, the near-field flow structure would undergo drastic changes upon removal of gravity in the microgravity environment. The present study was conducted to investigate this effect by simulating microgravity environment in the 2.2-second drop tower at the NASA Glenn Research Center. The non-intrusive, rainbow schlieren deflectometry technique was used for quantitative measurements of helium concentrations in buoyant and non-buoyant jets. Results in a steady jet show that the radial growth of the jet shear layer in Earth gravity is hindered by the buoyant acceleration. The jet in microgravity was 30 to 70 percent wider than that in Earth gravity. The microgravity jet showed typical growth of a constant density jet shear layer. In case of a self-excited helium jet in Earth gravity, the flow oscillations continued as the jet flow adjusted to microgravity conditions in the drop tower. The flow oscillations were however not present at the end of the drop when steady microgravity conditions were reached.

Author

Gravitational Effects; Helium; Jet Flow; Near Fields; Microgravity

20030005603 Boston Univ., Dept. of Aerospace and Mechanical Engineering, Boston, MA USA

Sonoluminescence in Space: The Critical Role of Buoyancy in Stability and Emission Mechanisms

Thomas, Charles R., Boston Univ., USA; Holt, R. Glynn, Boston Univ., USA; Roy, Ronald A., Boston Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 531-542; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Sonoluminescence is the term used to describe the emission of light from a violently collapsing bubble. Sonoluminescence ("light from sound") is the result of extremely nonlinear pulsations of gas/vapor bubbles in liquids when subject to sufficiently high amplitude acoustic pressures. In a single collapse, a bubble's volume can be compressed more than a thousand-fold in the span of less than a microsecond. Even the simplest consideration of the thermodynamics yields pressures on the order of 10,000 ATM, and temperatures of at least 10,000K. On the face of things, it is not surprising that light should be emitted from such an extreme process. Since 1990 (the year that Gaitan discovered light from a single bubble) there has been a tremendous amount of experimental and theoretical research in stable, single-bubble sonoluminescence (SBSL), yet there remain at least four unexplained phenomena associated with SBSL in 1g: the light emission mechanism itself, the existence of anisotropies in the emitted light, the disappearance of the bubble at some critical acoustic pressure, and the appearance of quasiperiodic and chaotic oscillations in the flash timing. Gravity, in the context of the buoyant force, is implicated in all four of these. We are developing KC-135 experiments probing the effect of gravity on single bubble sonoluminescence. by determining the stability boundaries experimentally in microgravity, and measuring not only light emission but mechanical bubble response, we will be able to directly test the predictions of existing theories.

Author

Bubbles; Buoyancy; Microgravity; Sonoluminescence; Stability; Light Emission

20030005673 Utah State Univ., Dept. of Physics, Logan, UT USA

A Study of Magnetic Storm Current Systems by the Application of Wavelet Analysis to Ground-Based Magnetograms

Cade, William B., III; Sep. 05, 2002; 136p; In English

Report No.(s): AD-A408141; CI02-512; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Ground-based magnetograms are used to measure the intensity of magnetic storms, yet the relative contributions of the current systems involved have been debated for decades. Wavelet analysis is a technique to analyze signals with complex content and is well suited to the analysis of time-series data. I applied wavelet analysis to ground magnetograms to extract information about magnetic storms current systems. The analysis showed three components at low-and mid-latitudes: 3-6 hours, 12-25 hours, and is greater than 30 hours, with each most likely associated with different current systems. Wavelet analysis also enabled the separation of directly driven and unloading components in high- latitude magnetic data. This allowed a comparison of low- and high-latitude substorm measurements to calculate the configuration of the substorm current wedge. Reasonable wedge configurations were found that matched the magnetic measurements. (135 pages)

DTIC

Geomagnetism; Magnetic Storms; Wavelet Analysis; Ionospheric Currents; Air Currents

20030005685 Michigan Univ., Ann Arbor, MI USA

Modeling the Absorbing Aerosol Index

Penner, Joyce, Michigan Univ., USA; Zhang, Sophia, Michigan Univ., USA; [2003]; 17p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG5-7681; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We propose a scheme to model the absorbing aerosol index and improve the biomass carbon inventories by optimizing the difference between TOMS aerosol index (AI) and modeled AI with an inverse model. Two absorbing aerosol types are considered, including biomass carbon and mineral dust. A priori biomass carbon source was generated by Liousse et al [1996]. Mineral dust emission is parameterized according to surface wind and soil moisture using the method developed by Ginoux [2000]. In this initial study, the coupled CCM1 and GRANTOUR model was used to determine the aerosol spatial and temporal distribution. With modeled aerosol concentrations and optical properties, we calculate the radiance at the top of the atmosphere at 340 nm and 380 nm with a radiative transfer model. The contrast of radiance at these two wavelengths will be used to calculate AI. Then we compare the modeled AI with TOMS AI. This paper reports our initial modeling for AI and its comparison with TOMS Nimbus 7 AI. For our follow-on project we will model the global AI with aerosol spatial and temporal distribution recomputed from the IMPACT model and DAO GEOS-1 meteorology fields. Then we will build an inverse model, which applies a Bayesian inverse technique to optimize the agreement of between model and observational data. The inverse model will tune the biomass burning source strength to reduce the difference between modelled AI and TOMS AI. Further simulations with a posteriori biomass carbon sources from the inverse model will be carried out. Results will be compared to available observations such as surface concentration and aerosol optical depth.

Author

Aerosols; Biomass Burning; Wind (Meteorology); Optimization; Mathematical Models

20030005690 Alabama Univ., Office of Research Administration, Huntsville, AL USA

UAH Analysis of TIDE/PSI Data for ISTEP Solar Maximum Extended Mission Final Report, 1 Feb. 1999 - 30 Apr. 2002

Comfort, Richard H., Alabama Univ., USA; Horwitz, James L., Alabama Univ., USA; [2002]; 5p; In English

Contract(s)/Grant(s): NAG5-8034; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

During the course of this research, several investigations have been carried out at both high and low altitudes. The low altitude studies are those associated with perigee observations of ion field-aligned flows measured by POLAR/TIDE near 5000 km altitude. High altitude studies employed ion observations near apogee (above 6 R(sub E) geocentric). In both cases the observations occur at high latitudes, in or near the polar regions: the southern polar region for the low altitude studies and the northern polar region for the high altitude studies. A study of the relationship between field-aligned flow velocities, fluxes, and densities to convection speeds was published in the Journal of Atmospheric and Terrestrial Physics . Here we have demonstrated an anti-correlation between the O+ densities and the convection speeds, and a correlation between the parallel upward velocities and the convection speeds, and have discussed these results as being compatible with the Cleft Ion Fountain concept for supplying O(sup +) ions to the polar cap magnetosphere. Another topic investigated was the relationship between TIDE-observed upward and downward parallel O(sup +) bulk velocities near 5000 km altitude over the southern polar regions, and near-simultaneous auroral observations by the Ultra-Violet Imager. We have prepared several overlaid plots of such auroral images across an MLT-ILAT dial plot of the polar regions with upward and downward velocities, as well as other parameters such as ion densities

and fluxes. The overlaid plots show quite nicely how upward velocities and crossovers between upward and downward velocities occur in association with auroral forms, while downward flows are associated with dark regions of the polar cap.

Derived from text

Atmospheric Physics; Convection; Flow Velocity; High Altitude; Low Altitude; Solar Maximum Mission

20030005722 Georgia Inst. of Tech., School of Civil and Environmental Engineering, Atlanta, GA USA

Fragility Analysis of Concrete Gravity Dams Final Report

Tekie, Paulos B.; Ellingwood, Bruce R.; Sep. 2002; 230p; In English

Contract(s)/Grant(s): DACW31-99-P-0479

Report No.(s): AD-A408107; ERDC/ITL-TR-02-6; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Concrete gravity dams are an important part of the nation's infrastructure. Many dams have been in service for over 50 years, during which time important advances in the methodologies for evaluation of natural phenomena hazards have caused the design-basis events to be revised upwards, in some cases significantly. Many existing dams fail to meet these revised safety criteria and structural rehabilitation to meet newly revised criteria may be costly and difficult. A probabilistic safety analysis (PSA) provides a rational safety assessment and decision-making tool managing the various sources of uncertainty that may impact dam performance. Fragility analysis, which depicts the uncertainty in the safety margin above specified hazard levels, is a fundamental tool in a PSA. This study presents a methodology for developing fragilities of concrete gravity dams to assess their performance against hydrologic and seismic hazards. Models of varying degree of complexity and sophistication were considered and compared. The methodology is illustrated using the Bluestone Dam on the New River in West Virginia, which was designed in the late 1930's. The hydrologic fragilities showed that the Bluestone Dam is unlikely to become unstable at the revised probable maximum flood (PMF), but it is likely that there will be significant cracking at the heel of the dam. On the other hand, the seismic fragility analysis indicated that sliding is likely, if the dam were to be subjected to a maximum credible earthquake (MCE). Moreover, there will likely be tensile cracking at the neck of the dam at this level of seismic excitation. Probabilities of relatively severe limit states appear to be only marginally affected by extremely rare events (e.g. the PMF and MCE). Moreover, the risks posed by the extreme floods and earthquakes were not balanced for the Bluestone Dam, with seismic hazard posing a relatively higher risk.

DTIC

Crack Propagation; Dams; Probability Theory; Hazards; Failure

20030006445 Mission Research Corp., Santa Barbara, CA USA

Evaluation of Environmental Effects on GPS Navigation Systems: Scintillation Data Collection Final Report, 1 Mar. 1996-31 Mar 1999

Milner, Brian R.; Jun. 2002; 5p; In English

Contract(s)/Grant(s): F19628-96-C-0060

Report No.(s): AD-A408426; AFRL-VS-TR-2002-1640; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Irregularities in the ionospheric electron density may cause amplitude and phase scintillations in GPS signals. To mitigate the effects of scintillation, the environment should be monitored. This report details the receiver features needed to provide the information and suggests a number of commercial receivers which meet the requirements.

DTIC

Global Positioning System; Navigation; Data Acquisition; Environmental Monitoring; Environment Effects; Scintillation

20030006669 Communications Research Lab., Japan

Development of CRL Fabry-Perot Interferometers and Observation of the Thermosphere

Iishi, Mamoru, Communications Research Lab., Japan; Okano, Syoichi, Communications Research Lab., Japan; Sagawa, Eiichi, Communications Research Lab., Japan; Murayama, Yasuhiro, Communications Research Lab., Japan; Watari, Shin-Ichi, Communications Research Lab., Japan; Conde, Mark, Communications Research Lab., Japan; Smith, Roger W., Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 155-164; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

The Fabry-Perot Interferometer (FPI) has long been established as a remarkably versatile high-resolution system for a wide range of spectroscopic purposes. This system screens out rays with a specific wavelength by letting multiple reflections occur between two glass plates called etalon. It has been used for estimating wind velocity and temperature in the mesosphere and the thermosphere which is much difficult to deduce with other observational methods. We have developed two types of FPI, the all-sky FPI and the scanning FPI as a part of international cooperative research project between CRIL and University of Alaska, Fairbanks. After several operations in Japan for improving total systems, we installed these instruments in Alaska. The scanning

FPI, installed in the Poker Flat Research Range, is used for vertical wind feature in the vicinity of aurora. The all-sky FPI, installed at the Eagle observatory, is used for ionosphere - thermosphere coupling study with cooperative observations with HF-radar. We have developed an automatic observation system for operating the instrument and data analyzing software for retrieving parameters with high precisions.

Author

Fabry-Perot Interferometers; Thermosphere; Spectroscopy; Auroras; Wind Measurement

20030006670 Communications Research Lab., Japan

Development of Millimeter-Wave Radiometers and Stratospheric Observation

Ochiai, Satoshi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 181-188; In Japanese; Copyright; Avail: Issuing Activity

Ground-based millimeter-wave radiometers have been developed and are used for observations of height profiles of stratospheric molecules and radicals. The radiometers have receivers in frequency bands of 200 or 270 GHz. The main target molecules of the stratospheric observation are ozone and ClO. We are starting observations in a suburb of Fairbanks, Alaska and a high latitudinal station in Canada. These instruments have capability of remote and automatic operations. The ozone profiles measured by the radiometer are compared with the measurements by ozonesonde. The observations of various molecules other than ozone are in progress.

Author

Microwave Radiometers; Millimeter Waves; Stratosphere

20030006671 Communications Research Lab., Japan

Observation of the Tropospheric Aerosol by Using a Mie Lidar: Observation at the Arid Region in China

Yasui, Motoaki, Communications Research Lab., Japan; Zhou, Jixia, Communications Research Lab., Japan; Mizutani, Kohei, Communications Research Lab., Japan; Itabe, Toshikazu, Communications Research Lab., Japan; Aoki, Tetsuo, Communications Research Lab., Japan; Liu, Lichou, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 211-220; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

We made intensive observations of the tropospheric aerosols at Shapotou, Ningxia province, China in the period from March to May 2001. Preliminary analysis of the data shows following features. (1) A dense atmospheric dust layer has always existed in the lowermost troposphere which top was 2 - 3 km above the ground surface. It is considered that the layer corresponded to the local mixing layer. (2) Distinct dust layers sometimes appeared at height around 4 or 5 km. It is considered that these layers were on the way of long-range transport. (3) In May, there was a case that tops of the local dust layer reached up to height around 5 km. In such a condition, injection of the dust into free atmosphere might have occurred easily. (4) Generally, aerosol optical depth was small in the early morning, and large in the period of afternoon to the evening. However, maximum optical depth was observed in the midnight in several cases.

Author

Troposphere; Aerosols; Mie Scattering; Optical Radar; Meteorological Radar

47

METEOROLOGY AND CLIMATOLOGY

Includes weather observation forecasting and modification

20030005508 Naval Postgraduate School, Monterey, CA USA

Summary of Research 2000, Department of Meteorology

Wash, Carlye H.; Davidson, Kenneth L.; Dec. 2001; 61p; In English

Report No.(s): AD-A408380; NPS-09-02-006; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report contains project summaries of the research projects in the Department of Meteorology. A list of recent publications is also included, which consists of conference presentations and publications, books, contributions to books, published journal papers, and technical reports. Thesis abstracts of students advised by faculty in the Department are also included.

DTIC

Meteorology; Operations Research

20030006262 Meteorological Satellite Center, Tokyo, Japan

Monthly Report of Meteorological Satellite Center *Monthly Report, Sep. 2002*

September 2002; In English; In Japanese; CD-ROM conforms to the ISO standard for volume and file structure; Copyright; Avail: Issuing Activity

The CD-ROM concerning the Monthly Report of the Meteorological Satellite Center (MSC) Contains the observation data derived from the Geostationary Meteorological Satellite (GMS) of Japan and the polar orbital meteorological satellites operated by NOAA. The CD-ROM contains following observation data. Full Disk Earth's Cloud, Cloud Image of Japan and its Vicinity, Cloud Amount, Sea Surface Temperature, Cloud Motion Wind, Water Vapor Motion Wind, Equivalent Blackbody Temperature, OLR (Out-going Longwave Radiation), Solar Irradiation, Snow and Ice Index, Orbit Data, Attitude Data, VISSR Image Data Catalog, (Cartridge Magnetic Tape (CMT), Micro Film), TOVS (TIROS Operational Vertical Sounder) Vertical Profile of Temperature and Precipitable Water, TOVS Total Ozone Amount. Although this user's guide is revised yearly, it may happen that a change of contents of the Monthly Report is not reflected in the user's guide, if the change is carried out between revisions of the user's guide. The latest contents of the Monthly Report and the detailed information of the contents are described in document files which are contained in the CD-ROM, Please read the document files.

Author

Satellite Observation; Meteorological Satellites; Clouds (Meteorology); Sea Surface Temperature; Water Vapor; Wind (Meteorology); Ozone

20030006265 NASA Langley Research Center, Hampton, VA USA

Meteorology Associated with Turbulence Encounters During NASA's Fall-2000 Flight Experiments

Hamilton, David W., NASA Langley Research Center, USA; Proctor, Fred H., NASA Langley Research Center, USA; [2002]; 12p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0943; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Initial flight experiments have been conducted to investigate convectively induced turbulence and to test technologies for its airborne detection. Turbulence encountered during the experiments is described with sources of data measured from in situ sensors, groundbased and airborne Doppler radars, and aircraft video. Turbulence measurements computed from the in situ system were quantified in terms of RMS normal loads ($\sigma_{\Delta n}$), where 0.20 g is less than or equal to $\sigma_{\Delta n}$ is less than or equal to 0.30 g is considered moderate and $\sigma_{\Delta n}$ is greater than 0.30 g is severe. During two flights, 18 significant turbulence encounters ($\sigma_{\Delta n}$ is greater than or equal to 0.20 g) occurred in the vicinity of deep convection; 14 moderate and 4 severe. In all cases, the encounters with turbulence occurred along the periphery of cumulus convection. These events were associated with relatively low values of radar reflectivity, i.e. RRF is less than 35 dBz, with most levels being below 20 dBz. The four cases of severe turbulence occurred in precipitation and were centered at the interface between a cumulus updraft turret and a downwind downdraft. Horizontal gradients of vertical velocity at this interface were found to be strongest on the downwind side of the cumulus turrets. Furthermore, the greatest loads to the aircraft occurred while flying along, not orthogonal to, the ambient environmental wind vector. During the two flights, no significant turbulence was encountered in the clear air (visual meteorological conditions), not even in the immediate vicinity of the deep convection.

Author

Meteorological Flight; Atmospheric Turbulence; Airborne Radar; Doppler Radar; In Situ Measurement

20030006328 Woods Hole Oceanographic Inst., MA USA

Long-Term Evolution and Coupling of the Boundary Layers in the Stratus Deck Regions of the Eastern Pacific (STRATUS)

Vallee, Charlotte; Huang, Kelan; Weller, Robert; Aug. 2002; 128p; In English; Original contains color images

Contract(s)/Grant(s): NA81RJ1223

Report No.(s): AD-A408271; WHOI-2002-06; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The surface mooring component of the CLIVAR Long Term Evolution and Coupling of the Boundary Layers in the Stratus Deck Regions study (STRATUS) took place from October 2000 in the eastern tropical Pacific. As part of the Eastern Pacific Investigation of Climate Processes in the Coupled Ocean-Atmosphere System (EPIC), STRATUS is a CLIVAR study with the goal of investigating links between sea surface temperature variability in the eastern tropical Pacific and climate over the American continents. This study started a three-year occupation off Chili in order to collect accurate time series of surface forcing and upper ocean variability. The Upper Ocean Processes (UOP) Group at WHOI deployed one fully instrumented surface mooring near 200S 85W in October 2000, at the western edge of the stratocumulus cloud deck found west of Peru and Chile, to achieve

a good understanding of the role of clouds in the eastern Pacific in modulating atmosphere-ocean coupling. Data from the moorings will improve our understanding of the air-sea fluxes and be used to examine the processes that control sea surface temperature in the cold tongue/intertropical convergence zone (ITCZ) and in the stratus deck region. The first surface mooring (STRATUS 1) was deployed in October 2000 by the UOP group and replaced by a second mooring one year later with almost identical instrumentation (STRATUS 2). STRATUS 1 was equipped with meteorological instrumentation, including two Improved METeorological (IMET) systems. The mooring also carried Vector Measuring Current Meters (VMCMs), single point temperature, salinity and conductivity recorders, and an acoustic Doppler Current Profiler (ADCP) to monitor the upper 500m of the ocean. In addition to the traditional instruments, several other experimental instruments were deployed with limited success on the mooring line including an acoustic current meter, bio-optical instrumentation packages, and an a DTIC

Ocean Surface; Air Water Interactions; Control Surfaces; Sea Surface Temperature

20030006663 Communications Research Lab., Japan

Cloud Observation with CRL Airborne Cloud Radar (SPIDER)

Horie, Hiroaki, Communications Research Lab., Japan; Kuroiwa, Hiroshi, Communications Research Lab., Japan; Ohno, Yuichi, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 71-80; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

Cloud plays an important role of the transmission of radiation energy, but it was still remains with uncertainty. It is expected to observe three-dimensional distribution of cloud. Although it is difficult with usual weather radar, Communications Research Laboratory developed an Airborne Cloud Profiling Radar (SPIDER). Its sensitivity is -35 dBZ at 5km range. In this paper, observation theory and method are discussed. Effectiveness of cloud profiling radar is explained with cloud data, which was obtained with airborne measurement.

Author

Airborne Radar; Meteorological Radar; Clouds (Meteorology)

20030006668 Communications Research Lab., Japan

Recent Results and Future Plans of Atmospheric Study using CRL All-Sky Imagers

Kubota, Minoru, Communications Research Lab., Japan; Ishii, Mamoru, Communications Research Lab., Japan; Oyama, Shin-Ichiro, Communications Research Lab., Japan; Murayama, Yasuhiro, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 145-154; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

As part of an international cooperative research project between Communications Research Laboratory and Geophysical Institute of University of Alaska, we developed two all-sky imagers (CRL-ASI). We had conducted pilot observations in Japan, and developed some new observation techniques for atmospheric waves. We installed the CRL-ASI at Poker Flat (magnetic lat. 65.6N), Alaska, and started aurora/airglow observations from October 2000. CRL-ASI can be operated automatically, and controlled from CRL, Japan. Real-time summary data are opened to the public with WWW. Using these instruments, we successfully observed some new phenomena: simultaneous appearance of gravity waves and aurora, co-rotating aurora in the evening sector. These results show the advantage of sensitivity and spatial resolution of the CRL-ASI. Observation data by CRL-ASI will contribute to a study on the magnetosphere-ionosphere-thermosphere coupling.

Author

Imaging Techniques; Auroras; Gravity Waves; Airglow

20030006683 NASA Goddard Space Flight Center, Greenbelt, MD USA

Global Precipitation Measurement Program and the Development of Dual-Frequency Precipitation Radar

Iguchi, Toshio, Communications Research Lab., Japan; Oki, Riko, Communications Research Lab., Japan; Smith, Eric A., NASA Goddard Space Flight Center, USA; Furuhashi, Yoji, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 37-44; In Japanese; Copyright; Avail: Issuing Activity

The Global Precipitation Measurement (GPM) program is a mission to measure precipitation from space, and is a similar but much expanded mission of the Tropical Rainfall Measuring Mission. Its scope is not limited to scientific research, but includes practical and operational applications such as weather forecasting and water resource management. to meet the requirements of operational use, the GPM uses multiple low-orbiting satellites to increase the sampling frequency and to create three-hourly global rain maps that will be delivered to the world in quasi-real time. A dual-frequency radar (DPR) will be installed on the primary satellite that plays an important role in the whole mission. The DPR will realize measurement of precipitation with high sensitivity,

high precision and high resolutions. This paper describes an outline of the GPM program, its issues and the roles and development of the DPR.

Author

Precipitation (Meteorology); Meteorological Radar; Multispectral Radar; Meteorological Satellites

20030006692 Southern Research Inst., Birmingham, AL USA

Southern Fine Particulate Monitoring Project Progress Report

Williamson, A. D.; Oct. 2001; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-791700; No Copyright; Avail: National Technical Information Service (NTIS)

This quarterly report presents results and analysis of continuous on site ambient fine particulate data at the North Birmingham study site during the July September, 2000 study period. The continuous data include PM_{2.5} mass concentrations measured by TEOM, particle sulfate using the R&P 8400S sulfate monitor, particle size distributions measured by SMPS and APS monitors, and PM_{2.5} light scattering extinction coefficient as measured by nephelometer. The report also presents some initial notes on our operating experience with the 8400S sulfate analyzer. As described in the previous quarterly report, some persistent daily trends are seen in the particulate data, superimposed on a seasonal trend toward higher concentrations in warmer months. The sulfate mass fraction shows a markedly different time of day pattern from the balance of the particle mass, confirming the independent origin of this major mass fraction. The time variability of the major mass-bearing size fractions, and of the light-scattering potential, do not allow for a clean separation of independent size fractions. However, when the particle number averages are examined, the stronger time of day dependence of the smaller size fractions becomes more apparent, consistent with periods of higher formation of sub-100nm particles in early morning and in afternoon-evening periods.

NTIS

Air Pollution; Particulates; Deposition; Pollution Monitoring; Acids; Sulfur Dioxides

20030006730 Communications Research Lab., Japan

Polarimetric Rainfall Observation with CAMPR (CRL Airborne Multiparameter Precipitation Radar)

Hanado, Hiroshi, Communications Research Lab., Japan; Satoh, Shinsuke, Communications Research Lab., Japan; Nakagawa, Katsuhiro, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 63-70; In Japanese; Copyright; Avail: Issuing Activity

Rainfall observation was conducted with an airborne rain radar named CAMPR (CRL Airborne Multiparameter Precipitation Radar) during WMO-01 (Winter MCSs Observations over the Japan Sea-2001). Hydrometeor discrimination in rain system over the Japan Sea at winter season was examined with vertical profiles of polarimetric radar observables obtained with CAMPR.

Author

Polarimetry; Rain; Airborne Radar; Meteorological Radar

20030006740 Communications Research Lab., Japan

Long-Term Observations Using L-Band Wind Profiler in Asia

Ohno, Yuichi, Communications Research Lab., Japan; Leelaruji, Nipha, Communications Research Lab., Japan; Jain, Atma R., Communications Research Lab., Japan; Kozu, Toshiaki, Communications Research Lab., Japan; Masuda, Yoshihisa, Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 195-202; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

Wind profiler is a Doppler radar that can observe upper winds from the ground by receiving atmospheric turbulence echo. The Communications Research Laboratory (CRL) developed an L-band wind profiler and has been carrying out continuous wind observations at Koganei, Tokyo since 1993. Ministry of Posts and Telecommunications (presently, Ministry of Public Management, Home Affairs, Posts and Telecommunications) and CRL also installed L-band wind profilers at Bangkok, Thailand and Gadanki, India, and has been making wind observations in cooperation with the King Mongkut's Institute of Technology Ladkrabang (KMITL), Thailand and the National MST Radar Facility(NMRF), India. Seasonal and diurnal variation of winds and classification of rain type using those wind profiler data are shown in this paper.

Author

Doppler Radar; Meteorological Radar; Wind Measurement; Diurnal Variations

20030006742 Naval Postgraduate School, Monterey, CA USA

Meteorological and Model Traits Knowledge Bases for North Indian Ocean Tropical Cyclones

Spollen, Rachael A.; Sep. 2002; 140p; In English; Original contains color images

Report No.(s): AD-A408190; No Copyright; Avail: Defense Technical Information Center (DTIC)

These tropical cyclone Meteorology and Model Traits Knowledge Bases for the North Indian Ocean (NIO) complete the global coverage required for application of the Systematic Approach to tropical cyclone track forecasting introduced by Carr and Elsberry (1994). The database for the NIO Meteorological Knowledge Base includes 64 storms during 1991-2001, All of the 656 cases could be classified in three common synoptic patterns that have been found to apply in other basins, with no unique patterns. About 75% of the cases are in the standard pattern. This preliminary Model Traits Knowledge Base includes only eight tropical cyclones during 2000-2001, The model forecast track errors are relatively small, and only 33%, 62%, and 70% of the Navy global, regional, and UK Meteorological Office models, respectively, exceed 150 n mi at 72 h. Only 12 cases of large (greater than 225 n mi at 72 h) track forecast errors occur. Half of these large-error cases are associated with erroneous model predictions in the midlatitudes. One third of the large errors originate from improper model treatments of the tropical circulations, and the remaining two cases originate from erroneous initial cyclone positions. Since these are the same error sources as in other basins, the Systematic Approach has global application.

DTIC

Weather Forecasting; Indian Ocean; Cyclones

20030006756 Army Research Lab., White Sands Missile Range, NM USA

Mesoscale Model Data Preparation and Execution: A New Method Utilizing the Internet Final Report, Jul. 2000-Jul 2001

Kirby, Stephen F.; Nov. 2002; 36p; In English; Original contains color images

Report No.(s): AD-A408215; ARL-TR-2687; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In order to streamline and simplify the methodologies required to obtain and process the requisite meteorological data for mesoscale meteorological models such as the Battlescale Forecast Model (BFM) and mesoscale model Version 5 (MM5), a new method utilizing the Internet and Perl/Common Gateway Interface has been developed. In order to execute a mesoscale model, one must first gather 'large-scale initialization data', one example is the Naval Operational Global Atmospheric Prediction System (NOGAPS) data. In order to process this NOGAPS data, numerous shell scripts and FORTRAN code required editing and recompilation. Unless the user was quite familiar with the shell scripts and FORTRAN code, this process was very convoluted and time-consuming. The same was true utilizing mesoscale model Version 5 radiosonde observation raob and/or surface meteorological data as inputs to a model. to circumvent these problems, an internet site, was created to provide a simple means to both access and process NOGAPS, raob, and surface data. The backbone of this Internet site is Perl, which is a powerful script language.

DTIC

Data Processing; Scale Models; Internet Resources; Meteorology

48

OCEANOGRAPHY

Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics, and marine resources. For related information see also 43 Earth Resources and Remote Sensing.

20030005519 Woods Hole Oceanographic Inst., MA USA

Sea Floor Samples Laboratory Final Report, 1 Jan. 2001-31 Dec. 2002

Broda, James E.; Curry, William B.; Nov. 19, 2002; 5p; In English

Contract(s)/Grant(s): N00014-01-1-0278

Report No.(s): AD-A408528; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The main purpose of this project is to provide consistent curatorial support for the Woods Hole Oceanographic Institution's ongoing geological sampling programs. The project serves two principal purposes: first to facilitate the initial curation of incoming sea floor samples, and second to assist the many investigators from WHOI and elsewhere for whom collected samples may provide an important source of research materials. Core lab operations include the implementation of procedures for the description and curation of seafloor samples of all types and the distribution of these materials to members of the global oceanographic community. In addition, our staff prepares and deploys sea floor sampling tools used on field programs at WHOI and other institutions in the UNOLS consortium. Along with onshore sample curation activities, we're responsible for specifying and planning all aspects of marine geological sample acquisition programs including conception and design of equipment. We

provide a complete resource that includes not only modem sample archiving, but also sea-going expertise, and a large and growing inventory of highly tuned sampling equipment.

DTIC

Data Management; Oceanography; Geology

20030005717 Army Engineer Research and Development Center, Coastal and Hydraulics Lab., Vicksburg, MS USA

Salinity Changes in Pontchartrain Basin Estuary, Louisiana, Resulting from Mississippi River-Gulf Outlet Partial Closure Plans with Width Reduction *Final Report*

Tate, J. N.; Carrillo, A. R.; Berger, R. C.; Thibodeaux, B. J.; Aug. 2002; 42p; In English; Original contains color images

Report No.(s): AD-A408114; ERDC/CHL-TR-02-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Mississippi River-Gulf Outlet (MRGO) consists of a ship channel 36 ft deep and 500 ft wide, extending approximately 76 miles from the juncture of the Inner Harbor Navigation Channel and the Gulf Intracoastal Waterway in New Orleans, LA, to the -38 mlw (mean low water) -ft contour in the Gulf of Mexico. The purpose of the MRGO is to provide a deep-draft channel to the Port of New Orleans Inner Harbor Facilities. Since the MRGO's completion in January 1968, saltwater flux from the MRGO through direct connections to Lake Borgne and the Gulf Intracoastal Waterway has contributed to an increase in the salinity concentration of the lakes and Biloxi Marshes. This report presents the results of a numerical mode investigation used to predict average salinity changes that will occur in the Lake Pontchartrain Basin as a result of varying levels of depth and width closure of the MRGO below Lake Borgne. This report follows a previous study, ERDC/CHL TR-01-14, that modeled depth closure alone, which produced very low changes in salinity.

DTIC

Water Flow; Salinity

51

LIFE SCIENCES (GENERAL)

Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see categories 52 through 55.

20030005499 Johns Hopkins Univ., Baltimore, MD USA

Graduate Management Project: An Evaluation of the Johns Hopkins Outpatient Surgery Center Patient Satisfaction Survey

Evan, Barry; Oakers, Dorothy L.; Nov. 24, 1999; 71p; In English

Report No.(s): AD-A408314; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Changes in the health care market such as increased competition, managed care, and declining reimbursements provided incentive for health care organizations to seek better ways of doing business and many started embracing the quality culture. These changes in the health care market along with a shift to consumerism have forced virtually all health care organizations to face the challenge of defining and measuring quality. Customer or patient satisfaction is a widely accepted measure of quality. Numerous organizations use satisfaction surveys as the foundation for organizational improvement and the Johns Hopkins Health System is no different. The purpose of this study was to evaluate the patient satisfaction survey instrument used in the Johns Hopkins Outpatient Surgery Center and to provide recommendations on how surveying patient satisfaction in this service area might be improved. The objectives of the study in regards to evaluation of the current survey instrument were two-fold. The first part of the evaluation assessed the psychometric properties of the instrument using statistical analyses. The second part of the evaluation critically evaluated the survey instrument relative to the literature. The analyses of the survey indicated that the survey was adequate in term of validity and reliability. Nonetheless, suggestions on how to improve the survey are offered. Improving the survey using scientific methodology is a resource-consuming process. Based on this and other facts and the desire to benchmark with other academic medical centers it is recommended that an outside vendor be used to provide patient satisfaction survey services to the Outpatient Surgery Center.

DTIC

Medical Services; Clinical Medicine; Surgery; Surveys; Patients

20030005509 Wayne State Univ., Detroit, MI USA

Development of Pro-Peptide Immunotherapy for Breast Cancer *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Wei, Wei-Zen; Jul. 2002; 26p; In English

Contract(s)/Grant(s): DAMD17-99-1-9244

Report No.(s): AD-A408383; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study tests whether breast cancer can be eliminated by immunization with foreign peptides followed by delivery of peptides to tumors. We proposed to (1) establish an in vitro assay to measure tumor growth inhibition, (2) synthesize pro-peptides for activation at the tumor site by beta-glucuronidase, and (3) develop human CTL line and measure pro-peptide activity with human CTL. We tested two methodologies for synthesizing Flu MP58 pro-peptide. Condensation of Beta-glucuronide conjugated glycine to octapeptide ILGFVFTL was superior when compared to direct conjugation of beta-glucuronide to the nonapeptide GILGFVFTL. A human CTL line to MP58 was established by repeated stimulation of CD8 T cells with MP58 loaded antigen presenting cells. MP58 loaded T2 cells were lysed by CTL at E:T ratio of 10:1 - 2:1. The same CTL did not lyse T2 cells loaded with pro-peptide beta-Glu-MP58 unless beta-glucuronidase was added to the culture, further demonstrating liberation of active MP58 from the prodrug to mark tumor cells for CTL lysis. These results demonstrate that peptide prodrugs can be converted by beta-glucuronidase to active peptide and mark tumor cells for CTL mediated lysis.

DTIC

Peptides; Mammary Glands; Cancer; Immunology

20030005513 Brigham and Women's Hospital, Boston, MA USA

FACTS (Find Appropriate Clinical Trials) for You: A Computer-Based Decision Support System for Breast Cancer Patients Final Report, 20 Apr. 1998-19 Apr 2002

Ohno-Machado, Lucila; May 2002; 90p; In English

Contract(s)/Grant(s): DAMD17-98-1-8039

Report No.(s): AD-A408466; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

We have built a prototype of a web-based system that matches patients to NCI-listed clinical trial eligibility criteria. The system consists of a protocol encoder, an expression evaluator and inference engine that can handle uncertainty (via Bayesian belief networks), and user interfaces customized for the patient and the health care provider. We use an object-oriented model and standard nomenclature (UMLS) in this system. We use measures of value of information in the dynamic creation of data entry forms. We have completed a formative evaluation of the system, by comparing its ranked list of trials to those of two oncologists for the same retrospective cases of stage IV breast cancer collected from the Brigham and Women's Hospital. We have also elicited the oncologists' impressions of the quality of recommendations given by the system. Although the number of cases and protocols was limited in this experiment, the results suggest that systems such as this one can select appropriate trials for a given patient, even when presented with incomplete or uncertain information.

DTIC

Data Processing; Cancer; Mammary Glands

20030005592 Notre Dame Univ., Dept. of Chemical Engineering, IN USA

Blood Cell Migration in Pressure-Driven and Electrokinetic Flows

Chang, Hsueh-Chia, Notre Dame Univ., USA; Takhistov, Paul, Notre Dame Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 447-448; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We report our preliminary results on the transverse migration of red blood cells and other particles when they are driven electro-kinetically and by pressure-driven flows in micro-channels. The overall objective is to explain the Fahraeus-Lindqvist effect in blood circulation dynamics-blood cells tend to migrate and aggregate at the blood vessel axis and reduce the overall viscous dissipation in the process. At the same hematocrit (blood cell concentration), blood cell flux at smaller capillaries is higher than in the large ones because of this effect. To avoid blood cell accumulation and depletion, the physiological dynamics maintain the hematocrit for small vessels at a level significantly lower than that in larger ones. However, the migration disappears for capillary radii beyond 250 microns. Hence, hematocrit is uniform within large blood vessels above this cutoff radius. This curious micro-circulation phenomenon has not been satisfactorily explained and is the focus of our research. Once the transverse migration mechanisms for blood cells and other micro-particles are understood, we also intend to exploit the principles to design electrophoretic and flow separation methods for micro-particles, including blood cells. We drive mouse blood and human blood suspensions in a mm-size capillary and a Hele-Shaw slot with a mm-size gap. They are driven by both a pressure-driven flow applied by a syringe and an electrokinetic flow due to a longitudinal electric field of about 50 V/cm. Significant lateral migration and aggregation are only observed in the former for both concentrated and dilute suspensions. For dilute blood suspensions, the bi-convex doughnut-shaped blood cells form a single file with their axis roughly aligned in the direction of flow. Some precession about this axis is observed in a Hele-Shaw slot. In electrokinetic flow, there is a very thin depleted marginal layer of less than a micron but otherwise no blood cell segregation/migration is observed. Since the electro-osmotic flow field is shear-free away from

the Debye layer, we conclude that lateral migration is only possible in the presence of bulk shear. However, migration is not observed in pressure-driven flow experiments with ion-exchange granules of dimensions similar to blood cells. A preliminary scaling analysis suggests that the migration is only possible with bulk shear, particle deformation and non-spherical geometry. Inertia is ruled out due to the miniscule particle Reynolds number. Without deformation, an ellipsoid is shown to rotate in the vorticity direction but the net lateral hydrodynamic force is zero. The migration scenario is quite different, however, if an electric field is applied and if the particles are charged. The Maxwell stress can also impart a torque on an asymmetric particle. However, the direction of this torque exerted by the electrokinetic stress depends on the inclination of the ellipsoid whereas that from the bulk hydrodynamic shear depends on the vorticity of the bulk velocity field. This vorticity changes sign across the capillary axis. Consequently, if electrophoretic motion and hydrodynamic shear are both present, the two torques can balance at a particular equilibrium inclination angle that is not parallel to the flow direction. This angle is also different for different hydrodynamic vorticities. We hence predict a preferred inclination angle for a rigid ellipsoid that is driven electro-phoretically in a pressure-driven flow field. This non-zero angle also implies a net migration even for rigid particles. Preliminary experimental evidence of this new migration mechanism will also be reported. Since blood cells possess significant surface charge, their electrophoretic motion in the presence of a shear flow is quite different from that of a pure pressure-driven flow. We have also investigated the transport of blood cells by AC dielectrophoresis at hundreds of kilo Hz. A sub-millimeter electrode configuration is designed to produce a non-uniform AC electric field. The blood cells are observed to polarize in the AC field and aggregate along the field lines. They then migrate slowly across the field lines towards regions of low electric fields, as is the case in classical dielectrophoresis. Like all nonlinear electrokinetic phenomena, the dipole formation and the migration are both frequency and particle size dependent. We have exploited these properties to separate large fish blood cells from smaller mouse cells. However, unlike the classical dielectrophoresis, the polarization that occurs in the plasma electrolyte around the blood cell is quite different from that of a dielectric liquid. The high frequency required is expected to be due to the small migration/diffusive time of ions across the blood cell Debye layer. A parallel theory is being pursued to explain this nonlinear AC electrokinetic phenomenon of blood cells. The theory captures the migration of ions within the Debye layer that causes the polarization responsible for aggregation and drift out of the field lines. It extends the classical theories for dielectrophoresis from dielectric liquids to electrolytes.

Author

Blood Vessels; Cells (Biology); Blood Circulation; Pressure Distribution; Electrokinetics; Flow Distribution

20030005594 North Carolina State Univ., Dept. of Mechanical and Aerospace Engineering, Raleigh, NC USA

A Criterion for the Development of Bioconvection Instability in a Suspensions of Gyrotactic Motile Microorganisms in a Fluid Saturated Porous Medium

Kuznetsov, A. V., North Carolina State Univ., USA; Avramenko, A. A., Academy of Sciences of the Ukraine, Ukraine; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 460-461; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, microfiche

In recent years, there has been increased interest in investigating spontaneous pattern formation in suspensions of motile microorganisms. This phenomenon is called bioconvection. Different from solid particles in traditional multiphase flow systems, motile cells are self-propelled. These microorganisms propel themselves by rotating flagella which are driven by reversible molecular motors that are embedded in the cell wall. They tend to swim in a particular direction in response to certain stimuli such as gravity (gravitaxis), light (phototaxis), or chemical gradients (chemotaxis). This investigation deals with bioconvection in a suspension of gyrotactic motile microorganisms. Gyrotaxis is a behavior typical for algal suspensions. The direction of swimming of gyrotactic microorganisms is determined by the balance of two torques. The first one is the viscous torque that acts on a body placed in a shear flow. The second torque is generated by gravity because the center of mass of a typical microorganism is displaced from its center of buoyancy. The microorganisms considered in this paper are heavier than water and gyrotactic behavior results in their swimming towards the regions of most rapid downflow. Because of that, the regions of downflow become denser than the regions of upflow. Buoyancy increases the upward velocity in the regions of upflow and downward velocity in the regions of downflow, thus enhancing the velocity fluctuations. The formation of almost regular patterns and gyrotactic plumes in algal suspensions has been documented in numerous experimental papers. This instability is similar to the Rayleigh-Benard convection instability but its development does not require the vertical temperature gradient. Despite the large number of publications on bioconvection in suspensions of gyrotactic microorganisms, very little has been done to address this type of bioconvection in a fluid saturated porous medium. This phenomenon is important because it may occur in nature (bioconvection in a layer of sand at the floor of a body of water that contains gyrotactic microorganisms) and may also have numerous applications. Upswimming of algal cells can be utilized to concentrate the cells, purify cultures, and separate vigorously swimming subpopulations. For these applications, bioconvection is undesirable, because it would prevent up-swimming cells from concentrating near the surface of the culture. To suppress bioconvection, a porous medium (for example, a surgical cotton wool) can be utilized, which must be

sufficiently permeable to allow cells to swim through it but also sufficiently tight to damp out bioconvection. For practical purposes, it is desirable to have the permeability of the porous medium as high as possible. This would insure that the cells can swim through it without cutting their tails off and this will also maximize the flux of the cells in the upward direction. Numerical results suggest that there is a critical value of the permeability of a porous medium. If permeability is smaller than this critical value, bioconvection does not occur and microorganisms simply swim in the upward direction; if it is larger than the critical value, bioconvection instability develops. The purpose of this research is to obtain the exact expression for the critical permeability based on a full three-dimensional stability analysis. As a result of this investigation, it is established that an infinite uniform dilute suspension of gyrotactic microorganisms in a fluid saturated porous medium is stable if the permeability of the porous medium is sufficiently small. A critical value of the permeability exists and if a porous medium has larger permeability than this critical value, the suspension is unstable. By performing a linear stability analysis, an analytical expression for the critical permeability of a porous medium is obtained. It is established that increasing the cell diffusivity and fluid viscosity increases critical permeability, while increasing the number density of the cells in the basic state, volume of the cell, density difference, gravitational acceleration, and the average swimming velocity of the cells decreases the critical permeability. This critical permeability value is also presented in terms of a critical Darcy number, which depends only on the cell eccentricity.

Author

Buoyancy; Convection; Microorganisms; Multiphase Flow; Saturation (Chemistry); Porosity; Gyroscopes

20030005597 Stanford Univ., Depts. of Chemical and Mechanical Engineering, Stanford, CA USA

Simulations of Drop Breakup and DNA Dynamics in Flow Through Arrays of Obstacles

Shaqfeh, Eric S. G., Stanford Univ., USA; Patel, Prateek, Stanford Univ., USA; Beck, Victor, Stanford Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 465; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

The flow through arrays of fixed obstacle beds provides important new methods for creating microstructural dynamics of drops and flexible macromolecules. In the latter instance, new separation techniques for DNA have been suggested based on the mobility change that comes from interactions with obstacles during flow (either electrophoretically driven or hydrodynamically driven motion). Interestingly, the dynamics is so diverse in terms of variation with obstacle concentration, strength of flow driving force, and molecular length, that large-scale simulation can play a very important role in determining where interesting flow parameter regimes are located. In this poster, we will present large-scale simulations of drops and DNA moving through fiber obstacle arrays. We will discuss the breakup mechanisms that are engendered in the former and compare our results to ongoing experiments. In the latter instance we will discuss the efficiency of separation in these arrays and isolate parameter regimes where separation is most efficient.

Author

Dynamic Structural Analysis; Drops (Liquids); Deoxyribonucleic Acid; Simulation; Fluid Dynamics

20030005664 Nebraska Univ., Medical Center, Omaha, NE USA

Breast Cancer Training Program Annual Report, 1 Jul. 2001-1 Jul 2002

Cowan, Kenneth H.; Shull, James D.; Aug. 2002; 37p; In English

Contract(s)/Grant(s): DAMD17-00-1-0361

Report No.(s): AD-A408104; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Breast Cancer Training Program (BCTP) in the Eppley Cancer Institute of the University of Nebraska Medical Center offers predoctoral and postdoctoral trainees a comprehensive training environment in breast cancer by supporting, in part, an outstanding breast cancer seminar program, a short course in cancer biology, a breast cancer focus group and by providing stipend support to trainees performing research that is highly relevant to breast cancer. In years one and two of this award we have provided stipends to five predoctoral and postdoctoral trainees. Four of five of the predoctoral trainees have completed their graduate training and have secured postdoctoral positions in outstanding laboratories in research areas directly related to breast cancer. One postdoctoral trainee has moved to another institution and five remain in training. Publications in highly ranked journals are beginning to result from the research of the BCTP trainees. We are currently evaluating a large group of highly qualified applicants for support in year three.

DTIC

Cancer; Mammary Glands; Education

20030005665 University of North Texas Health Science Center, Forth Worth, TX USA

High Density Lipoprotein Complexes as Delivery Vehicles for Breast Cancer Chemotherapy *Annual Report, 1 May 2001-30 Apr. 2002*

Lacko, Andras G.; May 2002; 25p; In English

Contract(s)/Grant(s): DAMD17-01-1-0582

Report No.(s): AD-A408103; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Reconstituted high density lipoprotein (rHDL) particles have been developed to incorporate water insoluble drugs to serve as drug delivery agents. Specifically, we have prepared taxol (TX) containing rHDL particles that are stable on rechromatography and preparative ultracentrifugation as no losses of TX from the complexes were seen during these studies. The rHDL/ TX complexes were as toxic to breast cancer cells as the commercial cremophor/taxol preparations. Taxol was avidly taken up by cancer cells from the rHDL/TX complexes, apparently by an SRB1 type receptor mediated mechanism. The uptake of core components from the rHDL complexes by a receptor mediated mechanism is supported by the observed expression of the SRB1 type receptors (demonstrated by immunoblotting) and by competition studies. Cancer cells were shown to exhibit considerably higher SRB1 receptor expression than fibroblasts, suggesting that the rHDL drug delivery system may be specifically targeting malignant cells.

DTIC

Lipoproteins; Chemotherapy; Cancer; Histochemical Analysis

20030005666 Toledo Univ., OH USA

Towards an Atomic Understanding of Double-Strand Break Repair: Crystal Structure of Human RAD52 Protein *Annual Report, 15 Jun. 2001-14 Jun 2002*

Ranatunga, Wasantha K.; Borgstahl, Gloria; Jul. 2002; 33p; In English

Contract(s)/Grant(s): DAMD17-00-1-0469

Report No.(s): AD-A408102; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Defects in recombination-based DNA repair lead to human breast cancer and familial degenerative diseases. The RAD52 epistasis gene products, especially the human RAD52 protein plays important role in double-strand break (DSB) repair. The focus of this work is to further understanding of the molecular basis of DSBs by solving the three-dimensional structure of hRAD52 and this will contribute a detailed understanding of the molecular mechanisms of breast cancer. The hRAD52 forms ring structure in solution and multiple level of aggregation of rings. We studied its multiple levels of self-association and stability using dynamic light scattering (DLS) and differential scanning calorimetry (DSC). to investigate the basis for the extreme stability of RAD52 that was discovered, two mutants were also studied, RAD52 (1-192) and RAD52.

DTIC

Proteins; Cancer; Crystal Structure; Ring Structures

20030005667 Pennsylvania Univ., Medical Image Processing Group, Philadelphia, PA USA

Molecular Determinants of tGolgin-1 Function *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Yoshino, Atsuko; Marks, Michael S.; Lemmon, Mark; Jul. 2002; 22p; In English

Contract(s)/Grant(s): DAMD17-01-1-0365

Report No.(s): AD-A408101; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

TGolgin-1 is a large peripheral membrane protein that consists predominantly of coiled coil regions and associates with the trans Golgi network (TGN) by virtue of a C-terminal GRIP domain. Our work has shown that overexpression of isolated GRIP domains from tGolgin-1 or a related protein, golgin-97, results in disruption of the structure, protein content, and function of the TGN, suggesting that tGolgin-1 and other GRIP domain proteins function in regulating TGN structure and function. This is important because signalling molecules required for initiating transformation and for metastasis rely on sorting and processing in the TGN. We have established tools to dissect the molecular basis of GRIP domain function and of the predicted N- terminal domain. More recently we have successfully used RNAi to eliminate expression of tGolgin-1 from mammalian cells. The results suggest that tGolgin-1 may play a more broad role in positioning the Golgi complex at the microtubule organizing center of the cell. This has important implications for a role of tGolgin-1 in cell motility required both for tumor metastasis and for the targeting of tumors by inflammatory cells and cytotoxic T lymphocytes.

DTIC

Proteins; Membranes; Cancer; Metastasis

20030005668 Albert Einstein Coll. of Medicine, Bronx, NY USA

Mtsl: A Molecular Link Between the Cytoskeleton and Breast Tumor Metastasis *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Bresnick, Anne R.; Jul. 2002; 6p; In English

Contract(s)/Grant(s): DAMD17-01-1-0122

Report No.(s): AD-A408099; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The objectives of this grant are: (1) examine how mtsl expression alters directed cellular motility in vitro; (2) generate myosin-IIA antibodies that mimic mtsl binding to examine how the regulation of myosin-IIA affects directed motility in vitro; and (3) utilize an intravital imaging system to evaluate the impact of mtsl expression on metastasis in live animal models. We have established high expressing MTC-GFP-mtsl and MTLn3-GFP-mtsl cell lines and are now poised to begin our intravital imaging studies, which will visualize the motile behavior of mtsl expressing tumor cells within the primary tumor, during intravasation and extravasation in situ. Importantly, these analyses will allow us to determine how mtsl expression impacts on the motile processes associated with invasion and metastasis in vivo and identify those steps in the metastatic cascade affected by mtsl expression. These cell lines will also be used in an in vitro assay to evaluate the effects of mtsl expression on chemoattractant-stimulated motility. This will allow us to obtain comprehensive behavioral phenotype and will identify which aspects of directed motility are sensitive to the expression of mtsl. We have established a quantitative glutathione-Sepharose pull-down assay for mapping the mtsl binding site on the myosin-IIA rod. Our analysis with a GST fusion of residues 1900-1961 indicates that the entire mtsl binding site is contained within the C-terminal 62 residues of the myosin-IIA heavy chain and further suggests that mtsl binds a linear sequence as previously proposed by us. This assay will be used to further narrow and define the mtsl binding domain for the production of a myosin-IIA antibody that mimics the effects of mtsl binding on myosin-II assembly and activity.

DTIC

Cells (Biology); Antibodies; Metastasis; Imaging Techniques

20030005670 Health Research, Inc., Buffalo, NY USA

Functional Interactions of the TACC2 Breast Tumor Suppressor Gene and Its Relevance to Breast Tumor Progression *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Still, Ivan H.; Jul. 2002; 8p; In English

Contract(s)/Grant(s): DAMD17-01-1-0208

Report No.(s): AD-A408097; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Recently, in the HMT-3522 cell line based model for breast tumor progression, TACC2 mRNA was shown to be downregulated in the more malignant clones of the series. This indicates that TACC2 downregulation is an important step in breast tumor progression. We have now shown that increased expression of TACC2 alters the in vitro cellular dynamics of breast cancer cell lines in a cell type specific manner. While TACC2 expression does not appear to inhibit cellular division, TACC2 does affect anchorage independent growth and cell migration. We have demonstrated that TACC2 interacts with hGCNS, a key component of transcriptional regulatory complexes. This suggests that TACC2 could play a role in the regulation of transcription through interaction with this molecule. The observation of specific effects of TACC2 expression in estrogen receptor negative compared to estrogen receptor positive cell lines may also support this idea. Therefore, further characterization of the role of the interaction of TACC2 with hGCNS in transcription will elucidate how alterations in this complex could promote the malignant phenotype.

DTIC

Genes; Cancer; Estrogens; In Vitro Methods and Tests

20030005677 Weizmann Inst. of Science, Rehovot Israel

Recycling of HER-ErbB Receptors: Rescue From Apoptosis and Targets for Immunotherapy *Annual Report, 1 Jun. 2001-31 May 2002*

Yarden, Yosef; Jun. 2002; 52p; In English

Contract(s)/Grant(s): DAMD17-00-1-0499

Report No.(s): AD-A408134; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Signals to multiply, migrate and outgrow blood vessels are mediated by growth factors of the EGF/neuregulin family. Concentrating on the membrane receptors for EGF and neuregulins, namely tyrosine kinases of the ErbB/HER family, our first task is to resolve mechanisms that normally restrain ErbB receptors. These efforts have led to the identification of a regulatory loop that allows collaboration between ErbB receptors and c-SRc, a major oncoprotein of breast cancers. According to our findings, c-SRc phosphorylates c-Cbl, a major restrainer of ErbB signaling, and leads to its proteasomal destruction. Consequently, tumor cells overexpressing c-SRc or active SRc mutants are unable to down-regulate ErbB proteins. Our Task 2

relates to a putative particle that modulates recycling of ErbBs. We report on the function of two components, Hgs and STAM, and their regulation by an ubiquitin ligase called Need4.

DTIC

Blood Vessels; Cells (Biology); Membranes; Apoptosis

20030005708 Texas Univ., M. D. Anderson Cancer Center, Houston, TX USA

BRCA2 and Genome Integrity Annual Report, 1 Jul. 2001-30 Jun. 2002

Su, Li-Kuo; Jul. 2002; 14p; In English

Contract(s)/Grant(s): DAMD17-00-1-0317

Report No.(s): AD-A408131; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The BRCA2 tumor suppressor gene has been suggested to play an important role in DNA repair and maintaining genome integrity. This suggestion, however, is mainly based on results obtained from studying mouse embryonic cells. The importance of BRCA2 in maintaining genome integrity of human somatic cells is not very clear. We have completed the Task 1, generation of Capan-1 derivatives that conditionally express wild type BRCA2. We have also carried out the first part of the Task 3, characterization of Capan-1 derivatives to genotoxic agents. Our results showed that there was no detectable difference in the sensitivity to radiation and DNA damaging chemicals between Capan-1 cells that express the wild-type BRCA2 and those do not. We have performed Task 2, generation of MCF7 and MCF-12A derivatives that do not express BRCA2. We have attempted the antisense cDNA approach but did not obtain any clone that expressed reduced level of BRCA2. In order to disrupt the BRCA2 gene, we have constructed a somatic gene-targeting plasmid.

DTIC

Cells (Biology); Genome; Cancer

20030005716 Toledo Univ., OH USA

Measurement of the Electron Density Distribution of Estrogens - A First Step to Advanced Drug Design Annual Report, 15 Jun. 2001-14 Jun 2002

Parrish, Damon A.; Pinkerton, A. A.; Jul. 2002; 115p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0468

Report No.(s): AD-A408115; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

It has been shown that the development of certain types of cancer can be hormone dependent. Estrogens, such as estradiol, have the ability to bind as ligands to the estrogen receptor in the first of many steps which could result in the activation or repression of genes critical in the mechanism of tumor growth. The principle objective of this proposal is to relate known biological reactions to physical properties such as point charges of atoms and the electrostatic potential. We are obtaining information about these electronic properties of estrogen derivatives from experimental determination of their electron density using high quality single crystal X-ray crystallography. During the past year, the focus was in completing Task 3, analysis of charge density data sets, for three systems (17beta estradiol-1/2MeOH, 17alpha estradiol-1/ 2H2O, and 17alpha-estradiol.urea). Data integration techniques have been refined to improve overall data quality and consistency. Topological analysis has been completed, while analysis of the electrostatic potential is nearly complete. initial comparisons have yielded some expected and unexpected results. These will be discussed in the body of the report Continued effort must be made to obtain more quality data of different systems to increase the amount of data we have to reference to.

DTIC

Estrogens; Cancer

20030005718 Fox Chase Cancer Center, Philadelphia, PA USA

Identification of Candidate Breast Cancer Susceptibility Genes Using a cDNA Microarray/CGH Approach Annual Report, 1 May 2001-30 Apr. 2002

Godwin, Andrew K.; May 2002; 11p; In English

Contract(s)/Grant(s): DAMD17-01-1-0521

Report No.(s): AD-A408112; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Familial breast cancer accounts for 15 to 35% of all breast cancers. Mutations in a number of genes are now known to cause susceptibility to breast cancer; the most notorious are the BRCA1 and BRCA2 genes. However, it has become evident that not all (or even the majority) of familial breast cancer families can be attributed to mutations in BRCA1 and BRCA2. In a recent study by the Breast Cancer Linkage Consortium, only one third of families with four or five cases of female breast cancer and no cases of ovarian cancer carry mutations in either BRCA1 or BRCA2. Smaller familial clusters are much more common than families with large numbers of cases, suggesting that a substantial proportion of familial clustering is not accounted for by mutations in

BRCA1 and BRCA2; therefore, there is a great need to discover other genes that contribute to this disease. We hypothesize that a heterozygous deletion in constitutive DNA or a homozygous deletion in multiple tumors and tumor types from a cancer-prone family will represent a strong candidate cancer predisposing gene. To establish this proof of principle, we have successfully developed a fluorescent-based DNA microarray assay to identify deletions, as small as a single exon, in heterogeneous tumor DNA.

DTIC

Genes; Cancer; Heterogeneity

20030005720 Pennsylvania State Univ., Coll. of Medicine, Hershey, PA USA

Relative Contribution of Ornithine Decarboxylase (ODC) Versus S-adenosylmethionine Decarboxylase (SAMDC) to Human Breast Cancer Progression and Development *Final Report, 1 Jul. 2001-30 Jun. 2002*

Manni, Andrea; Jul. 2002; 9p; In English

Contract(s)/Grant(s): DAMD17-01-1-0593

Report No.(s): AD-A408110; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Although polyamines (PA) play an important role in breast cancer phenotype, the relative contribution of the two PA biosynthetic enzymes, ornithine decarboxylase (ODC) and S-adenosylmethionine decarboxylase (SAMDC) is not known. Our data show that overexpression of SAMDC in MCP-7 breast cancer cells leads to a more benign biologic behavior characterized by decreased invasiveness in vitro and reduced tumorigenicity in nude mice. These effects may be mediated by the compensatory downregulation of ODC leading to reduced cellular putrescine and spermidine contents. In contrast, in experiments conducted in MDA-MB-435 and MDA-MB-231 breast cancer cells, we have observed that ODC adversely affects breast cancer phenotype and, most importantly, contributes to the development of distant metastasis. In the aggregate, our data point to ODC as an attractive target in the adjuvant therapy of breast cancer.

DTIC

Cancer; Mammary Glands; Enzymes

20030005723 Northwestern Univ., Evanston, IL USA

The Role of PRIP in Breast Cancer *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Zhu, Yijun; Reddy, Janardan K.; Badve, Sunil S.; Jul. 2002; 24p; In English

Contract(s)/Grant(s): DAMD17-01-1-0355

Report No.(s): AD-A408106; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Estrogen plays an important role in the normal breast and breast cancer development. Estrogens exert their cellular effects through ER that is a member of nuclear receptor superfamily. PRIP (Peroxisome proliferator receptor interacting protein) is a nuclear receptor coactivator that is amplified and overexpressed in breast cancer. The proposal was to investigate how the PRIP dysregulation contributes to abnormal growth and neoplastic development of breast. During the first year of the award, we have generated transgenic mice with integrated MMTV-PRIP lineages and heterozygous mice with conditional inactivated PRIP gene. About fifty estrogen-inducible genes have been identified by microarray hybridization. PRIP overexpression and amplification were found in about 60% and 10% of the breast cancers, respectively. PIMT (PRIP interacting protein with a methyltransferase domain) which interacts with and enhances nuclear receptor coactivator PRIP function was identified. PRMT2 (protein arginine methyltransferase 2) was found to act as a coactivator for estrogen receptor alpha. These findings not only advanced our understanding of estrogen signaling pathway but also suggested that nuclear receptor coactivator PRIP plays an important role in the breast cancer development.

DTIC

Estrogens; Cancer; Genes

20030005724 Yale Univ., New Haven, CT USA

Interdisciplinary Research Training in Breast Cancer *Annual Report, 1 Jul. 2001-30 Jun. 2002*

McCorkle, Ruth; Jul. 2002; 13p; In English

Contract(s)/Grant(s): DAMD17-00-1-0509

Report No.(s): AD-A408105; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this predoctoral and postdoctoral training program is to prepare clinical researchers who will impact the care of women with breast cancer or women who are at risk for breast cancer. The predoctoral program prepares the beginning researcher with the knowledge and skills necessary to develop and test clinical interventions. This program builds on the Yale School of Nursing's current doctoral program. Postdoctoral training prepares the investigator to conduct more complex studies which involve an interdisciplinary perspective or the need for sophisticated analytic techniques. The research training program

in breast cancer has completed its second year and all positions have been filled with outstanding trainees. Faculty across disciplines are collaborating and joint initiatives have been established. These activities are enhancing our ability to contribute to the knowledge base related to the care of women with breast cancer or women at risk to develop breast cancer.

DTIC

Cancer; Mammary Glands; Education

20030005725 West Virginia Univ., Morgantown, WV USA

Novel Histone Deacetylase Inhibitors *Annual Report, 15 Jun. 2001-14 Jun 2002*

Strobl, Jeannine S.; Martirosyan, Anna R.; Jul. 2002; 63p; In English

Contract(s)/Grant(s): DAMD17-00-1-0500

Report No.(s): AD-A408095; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The goal of this project is to develop new drugs for cell differentiation therapy of breast cancer. Our central hypothesis is antimalarials and structurally related quinoline compounds are histone deacetylase inhibitors and cause breast tumor cell differentiation and apoptosis. We have screened 21 compounds: 9 antimalarials and 12 additional quinoline ring bearing NSC compounds. Five novel breast tumor cell differentiation agents were identified, none of which was a direct inhibitor of histone deacetylase, and therefore promote breast tumor cell differentiation by novel mechanism(s). Two new histone deacetylase inhibitors were identified. Four (NSC 10010, NSC 305819, chloroquine and quinidine) of the 7 compounds also promoted apoptosis in cultured breast cancer cells. We conclude that these 4 quinoline ring compounds warrant further investigation as potential breast cancer therapeutic agents.

DTIC

Enzymes; Chlorine Compounds; Cells (Biology); Cancer

20030005726 Minnesota Univ., Minneapolis, MN USA

Expression of Metabolic and Apoptotic Genes During Treatment With Chemopreventive Agents for Breast Cancer *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Zhang, Xuexian; Jul. 2002; 6p; In English

Contract(s)/Grant(s): DAMD17-01-1-0332

Report No.(s): AD-A408094; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Effects of short-term (up to 2 weeks) treatment of rats with indole-3-carbinol (130) at three dose levels on mRNA expression of cytochrome P450 (CYP) in the liver and mammary gland and apoptotic activity in the mammary gland were examined. The mRNA transcripts for hepatic CYP1A1, IEL, and 2B1/2 and mammary CYP1A1 were upregulated after treatment with 130 at 250 mg/kg of body weight. This treatment also increased the oxidative metabolism of 17(3-estradiol (E2) and estrone (E1) by liver microsomes. In the mammary gland, activities of caspase-3, -8, and -9 were induced by 130 at lower dose levels (5 mg/kg for 4-dose and 25 mg/kg for 10-dose treatment). These results show that treatment with 130 at the high dose level altered the CYP complement and metabolite composition from E2 and E1, and that at the lower dose levels induced apoptosis in tumor-target organ. The data suggest that mechanism(s) of induction of apoptosis by 130 does not involve modulation of P450- dependent estrogen mechanism. Likewise, apoptotic activity was not induced in mammary tumors (adenocarcinomas) during post-carcinogen treatment of rats with 130 at 250 mg/kg (24 to 36 doses during 8-12 weeks). The level of apoptosis in mammary tumors was independent of treatment and likely reflected the intrinsic process of tumor apoptosis.

DTIC

Cancer; Prevention; Estrogens

20030005727 Baylor Coll. of Medicine, Houston, TX USA

Identification of New Genes that Regulate Telomerase and Telomere Length in Budding Yeast *Annual Report, 1 Jun. 2001-31 May 2002*

Pennock, Erin; Otero, Joel; Lundblad, Vicki; Jun. 2002; 18p; In English

Contract(s)/Grant(s): DAMD17-00-1-0143

Report No.(s): AD-A408093; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In order to identify proteins that play a role in telomeric processing, I took two approaches. The first was a candidate gene approach, and to this end, I directly tested a set of proteins for their involvement in processing the chromosome termini when end protection mechanisms are compromised. Secondly, I designed and carried out a large-scale genetic screen. The screen was based on the assumption that loss of processing at the telomere would make the essential protective function of CDC13 dispensable. To this end, I screened for genes that, when mutated, resulted in the ability to bypass the lethality associated with loss of CDC13 function. Unexpectedly, a large number of mutants were isolated from the screen, representing multiple disrupted genes,

indicating that many different genes/pathways can contribute to telomeric processing. Many of the genes characterized have telomere phenotypes in otherwise wild-type backgrounds, supporting a potential role in telomere metabolism and maintenance. One class of mutants appears to have been isolated owing to the ability of its members to enhance a previously described recombination pathway for telomere maintenance. Further analysis is critical to understanding whether these proteins play a direct role at the chromosome termini, and if so, by what mechanism they do so.

DTIC

Genetics; Proteins; Yeast

20030005750 Rhode Island Hospital, Providence, RI USA

Evaluation of GPR30, a Novel Estrogen Receptor, for Assessing Responsiveness to Anti-Estrogen Therapy *Annual Report, 1 Jun. 2001-31 May 2002*

Filardo, Edward J.; Jun. 2002; 15p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0419

Report No.(s): AD-A408091; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Antiestrogens are the most effective and widely administered therapy for the management of breast cancer. Their efficacy has been attributed to their ability to antagonize the estrogen receptor, and the presence of ER in breast tumor biopsy specimens correlates well with responsiveness to antiestrogen therapy. Still, one in four patients with ER-positive tumors do not respond to antiestrogens, while one in six patients with ER-negative breast tumors undergo objective tumor regression following antiestrogen therapy (Witliff, 1984). These clinical observations suggest that alternative mechanisms of estrogen action may regulate the growth and survival of breast tumors. We have provided evidence that estrogen acts independently of the known estrogen receptors; ER-alpha and ER-beta, via the G-protein coupled receptor, 6PR30, to regulate the EGFR-to-MAP K signaling axis (Filardo et al, 2000; reviewed in Filardo, 2001; Filardo et al, 2001). Moreover, we have shown that the antiestrogens, tamoxifen and faslodex (ICI 182, 780), also trigger GPR30-dependent regulation of this HB-EGF autocrine loop. Dysregulation of the EGFR-to-MAP K signaling axis is a common occurrence in breast cancer (Slamon et al, 1989, Sivaraman et al, 1997). The subject of this DOD award is to investigate the relationship between GPR30 expression and MAP K activity in breast tumor biopsy specimens obtained at first diagnosis or following antiestrogen or other adjuvant therapies. The results of these studies may lead to a further refinement in assessing responsiveness to antiestrogen therapy.

DTIC

Diagnosis; Estrogens; Cancer; Actuators

20030005764 Virginia Univ., Charlottesville, VA USA

Involvement of the Tyrosine Phosphatase SHP-1 in the Development of Breast Cancer *Annual Report, 1 Oct. 2001-30 Sep. 2001*

Lorenz, Ulrike M.; Oct. 2001; 43p; In English

Contract(s)/Grant(s): DAMD17-98-1-8347

Report No.(s): AD-A408151; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Purpose: to test the working hypothesis that SHP-1 is essential for controlling growth and differentiation of mammary epithelial cells and that its dysregulation contributes to the development of breast cancer. Scope: To biochemically and functionally characterize SHP-1 in human breast cancer cell lines and to define its biological function in normal epithelial cells. Major Findings: We have shown that SHP-1 localizes to the lipid raft. Moreover, our data indicate a functional difference between rafts- and non-rafts-associated fractions of SHP-1. While most of these studies have been performed in T cells and primary thymocytes, in initial experiments using human breast cancer cells, we have observed that limited amounts of SHP-1 localize to lipid rafts before and after EGF stimulation. In addition, we have obtained additional data showing that a transgenic mouse expressing SHP-1 under its own hematopoietic promoter is able to partially rescue the Motheaten phenotype.

DTIC

Cancer; Tyrosine; Hematopoietic System

20030005765 Georgetown Univ., Medical Center, Washington, DC USA

Comprehensive Postdoctoral Training Program in Breast Cancer Biology *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Dickson, Robert; Jul. 2002; 6p; In English

Contract(s)/Grant(s): DAMD17-00-1-0271

Report No.(s): AD-A408150; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The goal of this training program is to significantly extend our existing, highly successful Doctoral Training Program in Tumor Biology and several Cancer Center mechanisms that provide traditional postdoctoral training and junior faculty career

development. The program integrates faculty from the Lombardi Cancer Center programs in Cancer Prevention and Control and Cancer Genetics and makes use of the existing organizational structure of the Interdisciplinary Doctoral Training Program in Tumor Biology and incorporates a multi-disciplinary faculty who are devoted to research and education in breast cancer. We have one postdoctoral fellow who has successfully completed her fellowship in the program and another postdoctoral fellow who has successfully completed his first year and is now in his second year of research. We have recruited two postdoctoral fellows who have begun their first year of research in the program.

DTIC

Education; Genetics; Cancer

20030005766 New Mexico Univ., Albuquerque, NM USA

Synthesis of Selective Inhibitors of 17 β -Hydroxysteroid Dehydrogenase *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Barlow, Jeremy P.; Vander Jagt, David L.; Jul. 2002; 13p; In English

Contract(s)/Grant(s): DAMD17-00-1-0369

Report No.(s): AD-A408149; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Estradiol works at the level of the genetic material of the breast epithelial cells to control a wide range of genes that determine how fast the cell will grow. Breast cancer cells often remain sensitive to estradiol subsequent to becoming cancer cells. Type I 17 β -hydroxysteroid dehydrogenase (HSD) is the enzyme responsible for reducing the hormone estrone to estradiol in the epithelial cells of the breast. In many cases of breast cancer, elevated quantities of HSD have been observed associating it with abnormal cell proliferation. It has therefore become our task to try and inhibit HSD's catalytic function. We have discovered that dihydroxynaphthoic acids inhibit dehydrogenase enzymes, and we also know how to design variations among this class of inhibitors. With intentions of finding a new cancer therapeutic, it has been our goal to utilize structure-based drug design and molecular modeling to develop selective inhibitors of human HSD and to test these for activity against human breast cancer cells grown in culture.

DTIC

Enzymes; Genetics; Cells (Biology)

20030005767 Columbia Univ., New York, NY USA

Aging Families and Breast Cancer: Multi-generational Issues *Annual Report, 15 Jun. 2001-14 Jun 2002*

Raveis, Victoria H.; Jul. 2002; 16p; In English

Contract(s)/Grant(s): DAMD17-00-1-0215

Report No.(s): AD-A408147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

With the continuing shift of cancer care to community-based care the necessity to develop programs that enable the family to meet patients' needs for support and assistance is of paramount importance. The overall purpose in conducting this exploratory investigation is to obtain information that will: identify adult daughter caregivers in need of psychosocial support interventions to enable them to meet their mothers' needs for illness-related emotional support and assistance; reduce daughters' emotional stresses associated with this support role, and, enable the daughters to continue their caregiving role. To accomplish these objectives we are collecting data from a sample of 80 older women (aged 60+) receiving treatment for breast cancer and their adult caregiving daughters. The patients and their daughters each complete a questionnaire. The daughters also participate in a focused interview. Activities for Year 2 have focused on the continuation of the data collection effort and preliminary analyses of the qualitative interviews. to date, 32 patient-daughter dyads have been accrued into the study. The activities initiated during Year 1 have continued through Year 2 and will be ongoing through Year 3. The data being collected is informing our understanding of the psychosocial impact of cancer on the family.

DTIC

Emotional Factors; Sicknesses; Cancer; Dyads

20030005810 Mayo Clinic, Rochester, MN USA

Functional Analysis of Interactions Between 53BP1, BRCA1 and p53 *Annual Report*

Ward, Irene M.; Chen, Junjie; Jul. 2002; 18p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-01-1-0317

Report No.(s): AD-A408225; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

53BP1 has been reported to interact with the central DNA-binding domain of the tumor suppressor p53 and to enhance p53-dependent transcription. The C-terminus of 53BP1 contains a tandem BRCT motif. This domain was first identified in the C-terminal region of BRCA1 and has since been found in several proteins involved in various aspects of cell cycle control, recombination and DNA repair. The interaction with p53 and sequence homology with BRCA1 raised the possibility that 53BP1

may be involved in the maintenance of genomic stability. Western blot and immunofluorescence studies showed that upon DNA damage 53BP1 becomes hyperphosphorylated and forms discrete nuclear foci at the sites of DNA lesions. Co-immunostaining analyses revealed that these foci co-localize with BRCA1 foci several hours after DNA damage. Furthermore, small amounts of 53BP1 can be Co-immunoprecipitated with BRCA1 after irradiation but not in untreated cells. Like BECA1, 53BP1 becomes phosphorylated by ATM in vivo following ionizing radiation. Both proteins were also found to localize to stalled replication forks in response to replicational stress. These findings indicate that 53BP1 is involved in the early response to genotoxic stress. Given its interactions with p53 and BRCA1 it is reasonable to predict that 53BP1 might also act as a tumor suppressor.

DTIC

Cancer; Mammary Glands; Suppressors; Tumors; Ionizing Radiation; Proteins

20030005811 Pennsylvania Univ., School of Medicine, Philadelphia, PA USA

Rapid Assays of Oncogenic Aberrant ErbB Receptor Activation Using Fluorescence Microscopy Annual Report

Berger, Mitchel B.; Lemmon, Mark A.; Jul. 2002; 14p; In English

Contract(s)/Grant(s): DAMD17-01-1-0363

Report No.(s): AD-A408226; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Signaling by the four members of the erbB family of receptor tyrosine kinases involves their ligand-induced homo- and/or hetero-oligomerization. Ligand-induced receptor homodimerization appears to be driven straightforwardly by receptor extracellular domains, and can be recapitulated in vitro. By contrast, hetero-oligomerization cannot be detected in studies of isolated extracellular domains, and has only been observed for receptors in cellular membranes. We were therefore interested in determining which domains of an erbB receptor drive hetero-oligomerization. by analyzing a series of breast cancer cell-lines we found that EGF does not induce robust phosphatidylinositol-3-kinase (PI-3-K) activation in MCF-7 cells, since these cells express little to no EGF receptor. We visualize PI-3-K activation in vivo by observing the cytoplasm-to-plasma membrane translocation of a pleckstrin homology domain (fused to green fluorescent protein) that specifically recognized PtdIns(3,4,5) P3 (Grp1). We found that overexpression of wild-type EGFR in MCF-7 cells restored the ability of EGF to induce robust PI-3-K activation in these cells. Surprisingly, both a kinase-deficient EGFR mutant and a form of EGFR lacking all cytoplasmic sequences were equally effective in mediating EGE-induced PI-3-K activation. The EGFR extracellular domain tethered to the plasma membrane by a GPI anchor, or just added in excess (together with EGF) were also capable of inducing PI-3-K activation.

DTIC

Cancer; Mammary Glands; Carcinogens; Homology; Tumors; Tyrosine

20030005816 Science Applications International Corp., Reston, VA USA

An Epidemiologic Investigation of Health Effects in Air Force Personnel Following Exposure to Herbicides, Volume 1, Distribution under U.S. Government purpose rights Final Report, May 1997-Feb. 2000

Michalek, J. E.; Marden, H. E., Jr.; Robinson, J. N.; Elequin, V. V.; Miner, J. C.; Feb. 22, 2000; 1799p; In English

Contract(s)/Grant(s): F41624-96-C-1012

Report No.(s): AD-A408237; 01-0813-02-8280; XC-311TH HSW; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

This report summarizes results from the Air Force Health Study (AFHS). The AFHS is an epidemiological study to determine whether adverse health effects attributable to exposure to herbicides exist in veterans of Operation Ranch Hand Operation. Ranch Hand was the unit responsible for the aerial spraying of herbicides, including Herbicide Orange, in Vietnam from 1961 to 1971. A comparison cohort comprised Air Force veterans who served in Southeast Asia during the same time period that the Ranch Hand unit was active and who were not involved with spraying herbicides. The summarized data were collected during a physical examination administered between May 1997 and April 1998. of 1,149 eligible Ranch Hands, 870 (73.7%) participated and of 1,761 eligible Comparisons, 1,151(71.0%) participated. Statistical analyses assessed differences between Ranch Hands and Comparisons and associations between health-related endpoints and extrapolated initial dioxin, dioxin exposure category (Comparisons, background Ranch Hands, low Ranch Hands, high Ranch Hands), and dioxin measured in 1987. The study has insufficient statistical power to assess increases in the risk of rare diseases, such as soft tissue sarcoma. Diabetes and cardiovascular abnormalities represent the most important dioxin related health problems seen. From a public health perspective, these two areas demand the greatest attention.

DTIC

Epidemiology; Herbicides; Health; Armed Forces (USA); Cancer

20030005876 Army Cold Regions Research and Engineering Lab., Hanover, NH USA

Long-Term Survival of Enteric Microorganisms in Frozen Wastewater

Parker, Louise V.; Martel, C. J.; Oct. 2002; 64p; In English; Original contains color images

Report No.(s): AD-A408371; ERDC/CRREL-TR-02-16; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Microorganisms that are found in domestic wastewater and that can cause illness in humans include bacteria viruses protozoan cysts and helminth ova. This literature review attempts to determine whether organisms contained in a frozen sewage bulb in the Antarctic ice would survive for decades. This review briefly examines the structural differences between these organisms; examines the susceptibility of these organisms to chilling freezing thawing and frozen storage and the effect these processes have on the structural components of the organisms; and compares findings from field studies including some archeological studies on the ability of these organisms to withstand natural cold environments.

DTIC

Waste Water; Microorganisms; Cold Tolerance; Survival

20030005925 Department of Defense, Health Service Region 5, Wright-Patterson AFB, OH USA

The Health Enrollment Assessment Review (HEAR): Its Impact on Utilization

Judd, William D.; Apr. 14, 2000; 64p; In English; Original contains color images

Report No.(s): AD-A408312; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The purpose of this study was to analyze the Health Enrollment Assessment Review (HEAR) program to determine its impact on utilization. Additionally, the HEAR program is lacking useful metrics to track the success of the system. By conducting comparisons and developing predictor models, this study enables the HEAR program to have meaningful measures and accurately affect changes in the system. A series of six predictor models were developed to look at the six utilization variables of outpatient visits, emergency room visits, inpatient days, pharmacy prescriptions, laboratory procedures and radiology procedures. This analysis compared two groups of beneficiaries. Those that successfully completed the HEAR (HEAR group) and those that have not completed the HEAR (No HEAR group). This study randomly selected a sample population of 748 Prime beneficiaries enrolled to the Wright Patterson Medical Center. The HEAR and No HEAR groups each had 374 beneficiaries in the respective groups. The study collected utilization data and demographic characteristics on these beneficiaries for a 12- month period and subsequently analyzed it for differences and development of predictor models.

DTIC

Clinical Medicine; Medical Services

20030005926 Tripler Army Medical Center, Honolulu, HI USA

Determination of Tripler Army Medical Center Outpatient Service and Ambulatory Procedure Charges to the Veterans Administration, FY 2000

Perry, Mark; Durkee, Robert P.; Jun. 19, 2000; 42p; In English; Original contains color images

Report No.(s): AD-A408313; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this study was to determine Tripler Army Medical Center outpatient service and ambulatory procedure visit (APV) charges to the Veterans Administration for fiscal year 2000. First, relevant Medical Expense and Personnel System (MEPRS) cost was defined and a relevant MEPRS rate was calculated for each outpatient service cost center and APV category. Second, fiscal year 1999 utilization and associated cost of VA utilization of TAMC services was calculated. Third, relevant MEPRS cost was selected as a basis for billing for most fiscal year 2000 charges. Finally, a sensitivity analysis was developed comparing relevant MEPRS cost to increasingly steep discounts of the federally published Interagency Rate Reimbursement Schedule. The sensitivity analysis revealed a \$ 1,841 overall decrease in charges to the VA based on fiscal year 1999 billed utilization and proposed fiscal year 2000 rates.

DTIC

Clinical Medicine; Medical Services; Medical Personnel

20030005930 Academy of Health Sciences (Army), Health Care Administration, Fort Sam Houston, TX USA

A Comparative Evaluation of Structure, Process, and Outcomes Pre- and Post-Implementation of Primary Care Teams

Halverson, Valerie; Aug. 2000; 48p; In English; Original contains color images

Report No.(s): AD-A408328; Rept-38-00; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Department of Veterans Affairs (DVA) is faced with the major challenge of converting the nation's largest integrated health system from one focused on 'ill care' to one focused on 'well care'. When changes are made in structure and process elements of healthcare delivery, a system of measurement must be developed to demonstrate that outcomes have not been negatively impacted by these changes. Although the concept of each patient being assigned to one Primary Care Provider (PCP)

has been in place at the Cheyenne Veterans Affairs Medical Center (VAMC) for some time, inclusion of ancillary staff to complete a comprehensive primary care team has only recently been implemented (November 30, 1998). The purpose of this project was twofold: to assess whether sufficient reliable and valid data exist upon which to base a comparison of outcomes pre-and post-primary care team implementation; and if so, to make such a comparison. A para-analysis following the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) Clinical Value Compass approach was chosen to assess whether the implementation of primary care teams added value to the healthcare provided by the Cheyenne VAMC.

DTIC

Medical Services; Clinical Medicine

20030006089 Macro International, Inc., Calverton, MD USA

CD-ROM Technology to Increase Appropriate Self-Care and Preventive Behaviors Among Army and Navy Women *Final Report, 30 Sep. 1996-15 Aug. 2001*

Halverson, Lynn; Atkinson, Nancy; Sep. 2001; 371p; In English

Contract(s)/Grant(s): DAMD17-96-C-6091

Report No.(s): AD-A408295; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

The purpose of this report is to report the results of a study to investigate and address enlisted women's needs for basic gynecological and reproductive health education in order to enhance military readiness and general well-being. In the first phase of the study, a needs assessment was conducted in which the methods included: 1) a mail survey of knowledge, attitudes, and practices (KAP) from a random sample of Army and Navy clinicians and chiefs of military medical departments; 2) focus groups with enlisted Army and Navy women and with their health care providers; and 3) a secondary analysis of a national survey of military personnel health related behaviors. Based on the results of these needs assessment data, we have determined implications for enlisted women's reproductive health. These data were used in the fourth year to design and begin development of a culturally sensitive, multimedia CD-ROM and accompanying materials. This intervention was tested in military medical clinics in a fifth project year to determine its ability to change knowledge, attitude, and behavioral intent regarding female reproductive health.

DTIC

Clinical Medicine; Gynecology; Medical Services; CD-ROM

20030006091 Duke Univ., Dept. of Biochemistry, Durham, NC USA

Instrumentation for the Interfacial Analysis for Biosensor Microsystems Containing Genetically Engineered Proteins *Final Report, 1 Apr. 2001-31 Mar. 2002*

Hellinga, Homme W.; Oct. 01, 2002; 3p; In English

Contract(s)/Grant(s): N00014-01-1-0559

Report No.(s): AD-A408298; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The combined use of an atomic force microscope and ellipsometer allows determination of the structure of immobilized protein layers (thickness, orientation, surface concentration, homogeneity), kinetics of layer formation, transport properties of ligand between bulk and protein layer, and stability of the protein layer as compared to solution stability. We have characterized monolayers formed by covalent attachment of E. coli periplasmic binding proteins to glass and other substrates, and found that the orientation of these proteins can be controlled precisely, and that the monolayers retain their ability to respond to analytes with a ligand-mediated hinge-bending conformational change.

DTIC

Proteins; Bioinstrumentation; Transport Properties; Ellipsometers

20030006324 Baylor Coll. of Medicine, Houston, TX USA

Role of the SOS Response in Stationary-Phase Hypermutation: A Model for Mutation in Oncogenesis and Chemotherapeutic Drug-Resistance *Annual Report*

McKenzie, Gregory; Jul. 2002; 48p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-99-1-9072

Report No.(s): AD-A408280; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The SOS response of Escherichia coli is the prototypic DNA damage repair and cell Cycle control% system, analogous to checkpoint control in eukaryotes. The SOS response includes blocking the cell cycle, global mutagenesis via more than one mechanism, and up regulation of DNA repair and recombination functions. Adaptive mutation is a mutational program in non-growing cells subjected to starvation and so is also a temporary mutagenic response to environmental stress. It entails global hypermutation, and previously, the signal transduction pathway from the environment to the DNA was unknown. Previously, we

demonstrated that adaptive mutation of a lac allele in *E. coli* is under control of the SOS response, and that SOS induced levels of component(s) other than or in addition to RecA (hRad51 homologue) are also involved.

DTIC

Cancer; Chemotherapy; Mutagenesis

20030006325 Maryland Univ., Biotechnology Inst., Baltimore, MD USA

Graduate and Undergraduate Training in Marine Environmental Biotechnology Final Report, 1 Jun. 1998-31 May 2002

Sowers, Kevin R.; Nov. 13, 2002; 5p; In English

Contract(s)/Grant(s): N00014-99-1-0312

Report No.(s): AD-A408279; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The overall objective of this project was to enable students to participate and contribute to our ongoing research on the identification and characterization of microbes that catalyze polychlorinated biphenyl (PCB)-dechlorinating processes in the environment. The specific objective was to provide students at the graduate and undergraduate levels with skills that will enable them to conduct independent research in marine environmental molecular biology.

DTIC

Molecular Biology; Microorganisms; Biotechnology; Education

20030006743 Chicago Univ., Chicago, IL USA

A New Model for Estimation of Breast Cancer Risk Final Report, 14 Jun. 1999-13 Jun 2002

Giger, Maryellen L.; Jul. 2002; 17p; In English

Contract(s)/Grant(s): DAMD17-99-1-9119

Report No.(s): AD-A408192; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Cancer risk is the probability that cancer will occur in a given population. Research on cancer risk seeks to identify populations with a high probability of developing cancer. The goal of this research is to merge a computerized analysis of mammograms, which characterizes the breast pattern, with information of a woman's personal and family histories into a novel model for use in estimating risk of breast cancer. We have shown that computer-extracted features of mammographic parenchymal patterns can be used in the prediction of breast cancer risk. This has been demonstrated using three approaches: (1) correlation with clinical models of Gail and Claus, (2) separation between women at low risk and those with a positive gene testing result, and (3) separation between women at low risk and those that have breast cancer. In addition, we have shown, that the inclusion of the mammographic features with age increase the predictive power over the use of age alone in the prediction of breast cancer risk. We have also shown that with our method, the performance of the features and the classifier are quite dependent on ROI location within the breast and only slightly dependent on ROI size.

DTIC

Mammary Glands; Probability Theory; Cancer

20030006746 Brooke Army Medical Center, Fort Sam Houston, TX USA

The Impact of Managed Care on Internal Medicine Graduate Medical Education at Brooke Army Medical Center

Koelsch, Angela A.; Jun. 2000; 65p; In English; Original contains color images

Report No.(s): AD-A408197; BAMC-3-00; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Brooke Army Medical Center (BAMC) is a 450-bed tertiary care hospital with a multi-fold mission to provide comprehensive patient care, medical education, and research. The implementation of managed care has caused BAMC's focus to shift from an academic role to a primary care role, with increased emphasis on productivity and cost-effectiveness. Successfully balancing managed care programs and graduate medical education (GME) programs has been especially challenging because managed care goals are often inconsistent with the traditional goals of a specialty driven, academic teaching institution. This project studied data on BAMC's Internal Medicine Residency Program (1993 - 1999) to identify changes attributable to implementation of managed care. Results showed both positive and negative impacts. It has increased the staff's focus on prevention and on their responsibility to provide a continuum of care to enrolled beneficiaries. This has had a positive influence on the procedure workload for internal medicine because it is a primary care service. However, research and workload data indicate that the environment for training and education is becoming more constrained.

DTIC

Management; Health

20030006748 Birmingham Univ., UK

Primary Adhesion in Enteromorpha. Cue Detection and Surface Selection in the Settlement and Adhesion of Enteromorpha Spores Final Report, 12 Jan. 1995-30 Nov. 2001

Callow, James A.; Callow, Maureen E.; Nov. 2001; 5p; In English

Contract(s)/Grant(s): N00014-96-0373

Report No.(s): AD-A408203; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Enteromorpha is the most important alga fouling hulls, whether coated with conventional Cu-based paints or foul-release silicones. Since fouling by Enteromorpha is increasing as a consequence of the increased deployment of TBT-free coatings, it is important to understand the processes involved in the initiation of fouling, i.e. spore settlement and adhesion. Our results provide the most comprehensive characterisation of the settlement and adhesion processes and the roles of surface-associated cues, of any soft-fouling species to date. We have shown that spores respond to chemical, physico-chemical, biological (microbial biofilm) and topographic cues. Novel insights have been gained on communication processes involved in the development of a micro-fouling community. Thirteen papers in refereed journals and several abstracts were published.

DTIC

Algae; Hulls (Structures); Fouling

20030006749 Birmingham Univ., UK

Evaluation of the Strength of Attachment of Enteromorpha Zoospores to Novel Polymer Surfaces Final Report, 4 Jan. 1999-31 Mar. 2002

Callow, James A.; Callow, Maureen E.; Mar. 2002; 5p; In English

Contract(s)/Grant(s): N00014-99-0311

Report No.(s): AD-A408204; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Enteromorpha is the most important macrofouling alga and the diatom Amphora is a dominant member of slimes that develop on all coatings including foul-release silicones. The objective of this research was to use these two species as models to understand fundamental aspects of adhesion and to apply this mechanistic understanding to a practical, laboratory scale evaluation of novel anti-fouling materials provided by other contractors. Two methods to apply hydrodynamic shear forces to adhered organisms were developed and used to characterize baseline adhesive properties on defined, model surfaces. A 5-point evaluation protocol was developed for novel test surfaces, incorporating quantitative settlement, adhesion and removal assays. Test surfaces provided by 7 contractors were iteratively evaluated and the results reported for further development. Six papers were published in refereed journals.

DTIC

Polymers; Antifouling; Zooplankton; Algae; Spores

20030006751 State Univ. of New York, Stony Brook, NY USA

Tissue Plasminogen Activator (tPA) Mediates Neurotoxin-Induced Cell Death and Microglial Activation Final Report, 1 Jul. 1999-30 Jun. 2001

Tsirka, Styliani-Anna E.; Jul. 2001; 62p; In English

Contract(s)/Grant(s): DAMD17-99-1-9502

Report No.(s): AD-A408209; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Neuronal death occurs in the brain during development and in pathological conditions, like Alzheimer's disease and stroke. Tissue plasminogen activator (tPA), a protease converting plasminogen to plasmin, is necessary for neurodegeneration. In mice lacking tPA (tPA^{-/-}), neurons are resistant to neurotoxic death. Delivery of tPA into tPA^{-/-} mice restores susceptibility to neuronal death, indicating that tPA is neurotoxic in the context of excitotoxic injury. Although tPA is synthesized by neurons, the increase in tPA upon injury derives primarily from activated microglia, the immune cells of the brain. Microglia in tPA^{-/-} mice demonstrate reduced activation. Using tPA as tool, we are determining whether microglia are neuroprotective or neurotoxic, and what are the cell types involved in the sequence of events that lead from injury to neuronal death. We have established primary cultures and obtained information from them on the source of tPA that initiates neurotoxin-induced cell death (Spec. aim 2), and have narrowed the region of tPA that promotes microglial activation (Spec. aim 1). Since exaggerated neurodegeneration is evident in pathological conditions, understanding the underlying mechanisms could prove beneficial for interfering with the pathologies.

DTIC

Death; Tissues (Biology); Physiological Defenses; Aging (Biology); Toxins and Antitoxins; Neurons

20030006752 Baylor Coll. of Medicine, Houston, TX USA

Provider Profiling: Specialty Referral Patterns of Primary Care Providers at Dwight David Eisenhower Army Medical Center Final Report, Jul. 1999-Jul 2000

Fisher, Linda W.; May 2000; 46p; In English

Report No.(s): AD-A408210; 4B-00; No Copyright; Avail: Defense Technical Information Center (DTIC)

Dwight David Eisenhower Army Medical Center (DDEAMC), Fort Gordon, Georgia, is the USA military's major referral center for the Southeast Region. The Southeast Regional Medical Command (SERMC) and Region 3 of the TRICARE network consists of approximately 1.02 million beneficiaries in seven states. Facilities within the region have voiced concern about perceived difficulty of access to specialty referral appointments. The objective of this study was to utilize provider profiling as a tool in order to answer three primary questions. First, is the difficulty in obtaining referral appointments at DDEAMC real or perceived? Secondly, are the referral patterns of the providers a contribution factor in the region's perceived inability to meet the demand for specialty appointments? and third, if the providers' referral patterns are a contributing factor, which provider behaviors need to be modified? The variables studied were the number of: 1) internal referrals and total visits by Primary Care Provider. 2) internal referrals by specialty. 3) external referrals, by Military Treatment Facility (MTF). 4) external referrals by specialty. 5) network contract referrals, by specialty referred to, and the referring MTF.

DTIC

Data Processing; Management; Health

20030006753 Indiana Univ., Indianapolis, IN USA

Role of DNA-Dependent Protein Kinase in Breast Cancer Development/ Progression Annual Report, 15 Jul. 2001-14 Jul 2002

Lee, Suk-Hee; Jul. 2002; 46p; In English

Contract(s)/Grant(s): DAMD17-00-1-0295

Report No.(s): AD-A408211; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

DNA-dependent protein kinase (DNA-PK) is a nuclear serine/threonine protein kinase involved in various DNA metabolism and damage signaling pathways. DNA damage activates DNA-PK, which in turn phosphorylates a number of key proteins involved in replication, repair, and transcription. Accordingly, DNA-PK has long been suspected as a factor involved in sensing and transmitting DNA damage signals to the downstream target, which eventually contributes to the genomic stability and prevention of cancer. The overall goal of this proposal is to explore the role of DNA-PK in the development and progression of breast cancer. Since DNA-PK is a DNA repair factor as well as involved in damage signaling pathway, levels of DNA-PK activity among breast cancer would contribute to their drug resistance and also provide the basis for selection of patients for treatment with chemotherapy drugs. From the first two years of our study, we concluded that a peptide-based inhibitor preventing DNA-PKs from forming a complex with Ku70/Ku80 significantly lowered DNA-PK activity. Furthermore, treatment of these breast cancer cells with target peptide significantly lowered the cell growth only in the presence of ionizing radiation, indicating that the peptide-based inhibitor exhibited a positive effect of on lowering drug resistance by specifically targeting DNA-PK in vivo. This result also validates a physiologic role for DNA-PK in chemotherapy drug resistance of breast cancers.

DTIC

Mammary Glands; Cancer

20030006754 Colorado Univ., Health Sciences Center, Denver, CO USA

Induction of Mammary Cancer by Activated Akt Annual Report, 1 Jul. 1999-30 Jun. 2002

Lyons, Tracy R.; Anderson, Steven; Schwertfeger, Kathryn; Jul. 2002; 16p; In English

Contract(s)/Grant(s): DAMD17-99-1-9147

Report No.(s): AD-A408212; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Akt is a serine/threonine protein kinase that suppresses apoptosis in response to a wide variety of stimuli (4-6;8;10-12). Overexpression of Akt has been identified in certain types of cancers (1-3;13;17). Prolactin induces activation of Akt; results described in this summary demonstrate that prolactin may induce activation of Akt through a src-like kinase->Cb1-> PI3K-> Akt pathway. Akt is activated in response to a number of growth factors involved in mammary gland development(198,15,139,473,263,196,197) we hypothesized that overexpression of Akt in the mammary gland may result in the suppression of apoptosis, possibly leading to tumorigenesis. We generated mice that express a constitutively active form of Akt in the mammary gland. Upon examination of the mammary gland during development in these transgenic mice, we have shown that Akt can suppress apoptosis during mammary gland involution. Our data also suggest that Akt may be involved in lipid synthesis during pregnancy and lactation. Finally, although the presence of myr-Akt in the mammary gland does not result in high

levels of spontaneous tumors, it is possible that Akt overexpression may result in the induction of a preneoplastic state and in the presence of other mutations, may result in tumorigenesis.

DTIC

Activation; Mammary Glands; Apoptosis; Cancer; Growth

20030006755 Civil Aeromedical Inst., Civil Aeromedical Inst., Oklahoma City, OK USA

An Accurate Method for the Determination of Carbon Monoxide in Postmortem Blood Using GC/TCD *Final Report*

Lewis, Russell J.; Johnson, Robert D.; Canfield, Dennis V.; Aug. 2002; 9p; In English

Report No.(s): AD-A408214; DOT/FAA/AM-02/15; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

During the investigation of aviation accidents, postmortem samples from accident victims are submitted to the FAA's Civil Aerospace Medical Institute for toxicological analysis. to determine if the accident victim was exposed to an in-flight/post crash fire or faulty heating/exhaust system, the analysis of carbon monoxide (CO) is conducted. While our laboratory predominantly uses a spectrophotometric method for the determination of carboxyhemoglobin (COHb), we consider it essential to confirm with a second technique based on a different analytical principle. Our laboratory encountered difficulties with many of our postmortem samples while employing a commonly used CC method. We believed these problems were due to elevated methemoglobin (MetHb) concentration in our specimens. MetHb does not bind CO, thus elevated MetHb levels will result in a loss of CO binding capacity. Since most commonly employed CC methods determine %COHb from a ratio of unsaturated blood to CO-saturated blood, a loss of CO binding capacity will result in an erroneously high %COHb value. Our laboratory has developed a new CC method for the determination of %COHb that incorporates sodium dithionite, which will reduce any MetHb present to Hb. Using numerous fresh human blood controls ranging from 1% to 67% COHb, we found no statistically significant differences between %COHb results from our new CC method and our spectrophotometric method. We then applied our new CC method to putrefied and non-putrefied postmortem samples. to validate the new CC method, postmortem samples were analyzed with our existing spectrophotometric method, a CC method commonly used without reducing agent, and our new CC method with the addition of sodium dithionite. As expected, we saw errors up to and exceeding 50% when comparing the unreduced CC results with our spectrophotometric method. With our new CC procedure, which incorporates a reducing agent, the error was virtually eliminated.

DTIC

Carbon Monoxide; Hemoglobin; Carboxylic Acids; Toxicology; Blood Volume

20030006760 Brooke Army Medical Center, Fort Sam Houston, TX USA

Identification of Bioethical Dilemmas, Ethical Reasoning, and Decision-Making in Military Emergency Medicine Departments

Scroggs, Kendra L.; May 2000; 73p; In English; Original contains color images

Report No.(s): AD-A408222; No Copyright; Avail: Defense Technical Information Center (DTIC)

Recent advances in medical technology and research have made possible an unprecedented level of health care for those living in economically advanced nations like the USA. Fast-acting pharmaceuticals, cardiac defibrillators, assisted-ventilation, telemedicine, artificial organs, and transplantation are just a few of the weapons in our medical arsenal today that simply did not exist only fifty years ago. Nowhere is this more evident than in the pre-hospital or emergency medicine arena, where providers are faced with advanced medical technology that has often made dying a choice rather than an inevitable event. Not coincidentally, the field of bioethics has also experienced unprecedented growth over the same time span, with many of the bioethical issues being driven by the power of our new technological medical prowess. All too often it seems as though medicine asks "Can we?" before asking "Should we?" and therefore many Americans are doubtful that bioethics can ever keep pace with rapidly changing technologies. As technologies advance and the healthcare environment changes, the struggle to identify pertinent bioethical issues has prompted numerous institutional efforts, including initiatives of the American Association of Bioethics, The Center for Bioethics, and the Hastings Center for Bioethics, whose goal is to expand bioethical education and stimulate discussion of bioethical issues.

DTIC

Telemedicine; Medical Services; Armed Forces (USA)

20030006761 DeWitt Army Community Hospital, Fort Belvoir, VA USA

Clinical Practice Guideline Selection, Development, Implementation, and Evaluation

Christon, Christopher M.; Feb. 2000; 82p; In English; Original contains color images

Report No.(s): AD-A408245; Rept-10-00; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This paper discusses issues relating to clinical practice guideline development and implementation, and recommends a step by step plan for guideline use in the Department of Defense. Individual clinical expertise and opinion has historically taken

precedence over an evidence based approach, which has resulted in large amounts of practice variation throughout the Military Healthcare System. Clinical practice guidelines attempt to reduce this practice variation and improve patient outcomes by using evidence based medicine and identifying best practices.

DTIC

Clinical Medicine; Defense Program

20030006762 Great Plains Regional Medical Command, Fort Sam Houston, TX USA

Predictors of Satisfaction with Access to Medical Care

Roou, Mary K.; Jun. 01, 2000; 36p; In English; Original contains color images

Report No.(s): AD-A408253; GPRMC-35-00; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this management project was to determine if there was a relationship between staffing, the number of exam rooms, clinic operating hours, ease of making an appointment; and satisfaction with access to medical care. Additionally, a predictive model was developed. The sample population came from the clinics within Brooke Army Medical Center for FY 98-99. Three types of clinics were chosen for this analysis: high cost, high volume, and high risk. Data was taken from the monthly customer satisfaction surveys for FY 98-99, the Medical Expense and Performance Reporting System from FY 98-99, and from the specific clinics. Correlation analysis and multiple linear regression were used. The results of this study demonstrate that demographic characteristics of the sample population account for 96% of the variation in patient satisfaction with access to medical care. When controlling for differences in demographics, the total model accounts for 98% of the variation in satisfaction with access to medical care. Furthermore, the "ease of making an appointment by phone (Q10a)" was the most predictive independent variable $t(26,191) = 13.549, p < .001$ followed by the "number of exam rooms" $t(26,191) = 2.888, p = .004$, the "urgent visit" $t(26,191) = 2.816, p = .005$, and 65 and older patients $t(26,191) = 2.169, p = .032$. This study demonstrates a direction for improving satisfaction with access to medical care, which is making it easier for our patients to make an appointment. Additional studies should be conducted MHS wide and alternative methods of making appointments should be studied.

DTIC

Clinical Medicine; Medical Services

20030006763 Sound Shore Medical Center, New Rochelle, NY USA

Creating a Business Plan and Projecting Revenue for a Cosmetic Laser Center in a Community Hospital

McDevitt, Matthew T.; May 01, 2000; 58p; In English

Report No.(s): AD-A408284; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In the USA today, cosmetic laser surgery is rapidly increasing as a popular method for physicians to treat aesthetic skin conditions. Patients desiring treatment are now able to choose more simple, non-invasive solutions such as laser technology to accomplish this. In early 1999, the hospital chief executive officer at Sound Shore Medical Center, a not-for-profit community hospital located in southern Westchester County, New York, began gathering information from several staff physicians and patients regarding the rapid rise in cosmetic laser surgery. A preliminary study of Sound Shore staff physicians indicated there would be an interest in using cosmetic lasers, particularly amongst the plastic surgeons dermatologists. Shortly thereafter, the hospital decided to purchase three of the most technologically advanced cosmetic lasers available in today's market. In October of 1999, the researcher was asked to assist in designing and developing a cosmetic laser center during an administrative residency at Sound Shore. This graduate management project discusses the major issues involved in creating a business plan and projecting revenue for a cosmetic laser center within a community hospital. Areas discussed are the budget; breakeven and cash-flow sensitivity analysis; pricing schedule development; hospital privileging criteria; and training and staffing issues. In January of 2000, the first cosmetic laser procedure was performed. As of May 2000, the center is beginning to meet forecasted volume levels.

DTIC

Cost Analysis; Medical Services; Physicians; Surgery

52 AEROSPACE MEDICINE

Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see 53 Behavioral Science. For the effects of space on animals and plants see 51 Life Sciences.

20030005953 Army Research Inst. of Environmental Medicine, Natick, MA USA

Application of the Physiological Strain Index (PSI) for Evaluation of Simulated Military Activities

Yokota, M.; Tharion, W. J.; Buller, M. J.; Hoyt, R. W.; Oct. 2002; 34p; In English; Prepared in collaboration with Geo-Centers, Inc., Natick, MA

Report No.(s): AD-A408496; USARIEM-TR-M-03/15; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Physiological Strain Index (PSI) (24) is a scale for measuring physiological strain in spontaneous response to work and heat stress using heart rate and core temperature. Previous PSI studies were conducted in controlled laboratory conditions. The purpose of this study was to examine if PSI patterns were different during field activities. In addition, whether intensities of activities, times of activities, types of movements in same activities, and environmental stress affect PSI levels were investigated. Twelve male volunteers (age: 26 +/- 4.0 SD yr; ht: 181 +/- 4 cm; and wt: 80.4 +/- 10.5 kg) participating in U.S. Marine Corps (USMC) infantry training at Quantico, VA, were studied. The PSI was calculated from measured heart rates and core temperatures during field activities. Five activities: firing, attack, preparation, meeting, moving--with at least four participants per activity were used in this study. These activities were further classified as "day" or "night" according to the times the activities occurred. Types of movement in attacks and moving activities were categorized as either "mechanized" or "non-mechanized," depending on whether vehicles were used. The Environmental Stress Index (ESI) (22), which summarizes the influence of air temperature, solar radiation, and relative humidity, was also calculated for the field conditions. Fisher's exact tests were conducted to examine if the PSI levels varied for activities, times of activities, types of movements, and ESI. The PSI levels were different for various activities. Fighting activities (firing and attack), in particular, attained high PSI levels with greater variability than non-fighting activities (pis less than 0.05). PSI levels were high during nighttime as compared to daytime fighting activities (pis less than 0.05). PSI levels in mechanized activities were not statistically different from those in non-mechanized activities (p>0.05). High ESI levels were associated with low PSI levels, and vice versa (pis less than 0.05). 7

DTIC

Military Operations; Temperature Effects; Physiological Responses; Armed Forces (USA)

53 BEHAVIORAL SCIENCES

Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.

20030005105 NASA Ames Research Center, Moffett Field, CA USA

An Analysis of U.S. Civil Rotorcraft Accidents by Cost and Injury (1990-1996)

Iseler, Laura, NASA Ames Research Center, USA; DeMaio, Joe, Army Aviation and Missile Command, USA; May 2002; 34p; In English

Contract(s)/Grant(s): RTOP 812-30-22

Report No.(s): NASA/TM-2002-209615; NAS 1.15:209615; A-00V0027; AFDD/TR-00-A-010; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A study of rotorcraft accidents was conducted to identify safety issues and research areas that might lead to a reduction in rotorcraft accidents and fatalities. The primary source of data was summaries of National Transportation Safety Board (NTSB) accident reports. From 1990 to 1996, the NTSB documented 1396 civil rotorcraft accidents in the USA in which 491 people were killed. The rotorcraft data were compared to airline and general aviation data to determine the relative safety of rotorcraft compared to other segments of the aviation industry. In depth analysis of the rotorcraft data addressed demographics, mission, and operational factors. Rotorcraft were found to have an accident rate about ten times that of commercial airliners and about the same as that of general aviation. The likelihood that an accident would be fatal was about equal for all three classes of operation. The most dramatic division in rotorcraft accidents is between flights flown by private pilots versus professional pilots. Private pilots, flying low cost aircraft in benign environments, have accidents that are due, in large part, to their own errors. Professional pilots, in contrast, are more likely to have accidents that are a result of exacting missions or use of specialized equipment. For both groups judgement error is more likely to lead to a fatal accident than are other types of causes. Several approaches to improving

the rotorcraft accident rate are recommended. These mostly address improvement in the training of new pilots and improving the safety awareness of private pilots.

Author

Rotary Wing Aircraft; Accident Prevention; Aircraft Safety; Pilot Training; Aircraft Accidents; Data Processing

20030005733 North Carolina Agricultural and Technical State Univ., Greensboro, NC USA

Assessment of Human Interaction with Virtual Environment Training Technology Final Report, Nov. 1999-Jun. 2002

Ntuen, Celestine A.; Yoon, S.; Oct. 2002; 46p; In English; Original contains color images

Contract(s)/Grant(s): F41624-00-1-0001; AF Proj. 1123

Report No.(s): AD-A408540; AFRL-HE-AZ-TR-2002; No Copyright; Avail: Defense Technical Information Center (DTIC)

This research investigated the evidence of performance improvement of piloting skills while using an immersive virtual environment (IVE) versus a nonimmersive virtual environment (NIVE) to train instrument pilot skills. The general hypothesis tested was whether there is equal improvement for people trained under IVE and NIVE. Subjects were tested in IVE and NIVE flight scenarios using three flying tasks normal crosswind approach and landing (NCAL), go-around (GA), and constant speed during climbing and descending (CSCD). Data were analyzed for two measures errors and error rate, for four dependent variables: altitude control, heading control, airspeed control, and vertical airspeed control. Overall, results failed to demonstrate enhanced training effectiveness for an immersive VR training environment compared to a desktop (nonimmersive) environment. These results indicate that the cost tradeoff between the uses of IVE over NIVE are task dependent and influenced by the fidelity of training environments. The results obtained from the current experiment do justify some potential cost-saving advantage of IVE over NIVE on selected task. For example, NIVE seems to provide training advantages on error rate reduction on control of vertical airspeed and altitude under NCAL tasks. Similarly, IVE seems to offer training advantages of error rate reduction on airspeed control and heading control under NCAL, and heading and vertical airspeed controls under GA tasks. However, the fact that either IVE or NIVE provides an increase in piloting task performance in some tasks needs to be considered in any training investment decision.

DTIC

Virtual Reality; Pilots; Pilot Performance; Human Performance; Altitude Control

20030006289 Defence Research and Development Canada, Ottawa, Ontario Canada

Canadian Forces Training and Mental Preparation for Adversity: Empirical Review of Stoltz 'Adversity Quotient (AQ) Training for Optimal Response to Adversity', A Review of the AQ Literature and Supporting Studies

Angelopoulos, Paul A.; Houde, Sebastien J. R.; Thompson, Megan M.; McCreary, Donald R.; Blais, Ann-Renee; Jul. 2002; 42p; In English

Report No.(s): AD-A408478; DRDC-TR-2002-147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report reviews the theory of the Adversity Quotient (AQ), and the associated training procedure developed by Stoltz (1997; 2000). This report covers three general areas. First, we present an overview of the AQ conceptual framework and training program. Second, the psychometric properties of the AQ are reviewed to determine if the proposed conceptual framework is supported quantitatively. Third, we critically review the current empirical literature associated with AQ. We also discuss the applicability of the AQ training procedure to the CF, in particular, the utility of current AQ training as a treatment for post-traumatic stress disorder (PT SD), learned helplessness, and to augment leadership training in a military context. Finally, we provide recommendations for the CF with regards to the proposed implementation of the AQ training as a proactive intervention. A critical review of the AQ and associated literature revealed that AQ is based on a number of sound theories implicated in psychological resiliency. However, while the AQ framework and training program may possess face validity in an industrial/organizational context, to date there is lack of empirical literature substantiating both the validity of the AQ framework and the training program in important ways. Thus, the implementation of current AQ training into a military environment must be approached with great prudence. It is recommended that all training materials require significant modification to be applicable to a military context, and that any implementation of a modified training program in the CF be accompanied by rigorous and independent program evaluation.

DTIC

Armed Forces (Foreign); Military Operations; Education; Stress (Physiology)

Includes human factors engineering; bionics, man-machine, life support, space suits and protective clothing. For related information see also 16 Space Transportation and 52 Aerospace Medicine..

20030005103 NASA Ames Research Center, Moffett Field, CA USA

The Identification and Modeling of Visual Cue Usage in Manual Control Task Experiments

Sweet, Barbara Townsend, NASA Ames Research Center, USA; September 1999; 353p; In English

Contract(s)/Grant(s): RTOP 522-14-00

Report No.(s): NASA/TM-1999-208798; NAS 1.15:208798; IH-004; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

Many fields of endeavor require humans to conduct manual control tasks while viewing a perspective scene. Manual control refers to tasks in which continuous, or nearly continuous, control adjustments are required. Examples include flying an aircraft, driving a car, and riding a bicycle. Perspective scenes can arise through natural viewing of the world, simulation of a scene (as in flight simulators), or through imaging devices (such as the cameras on an unmanned aerospace vehicle). Designers frequently have some degree of control over the content and characteristics of a perspective scene; airport designers can choose runway markings, vehicle designers can influence the size and shape of windows, as well as the location of the pilot, and simulator database designers can choose scene complexity and content. Little theoretical framework exists to help designers determine the answers to questions related to perspective scene content. An empirical approach is most commonly used to determine optimum perspective scene configurations. The goal of the research effort described in this dissertation has been to provide a tool for modeling the characteristics of human operators conducting manual control tasks with perspective-scene viewing. This is done for the purpose of providing an algorithmic, as opposed to empirical, method for analyzing the effects of changing perspective scene content for closed-loop manual control tasks.

Author

Manual Control; Visual Stimuli; Flight Simulators; Cues; Mathematical Models; Algorithms; Operator Performance

20030005505 Sytronics, Inc., Dayton, OH USA

Civilian American and European Surface Anthropometry Resource (CAESAR). Volume II: Descriptions Interim Report, for Dec. 1997-Jun. 2002

Blackwell, Sherri; Robinette, Kathleen M.; Boehmer, Mark; Fleming, Scott; Kelly, Sara; Jun. 2002; 192p; In English; Prepared in collaboration with SAE International, Warrendale, PA and TNO human Factors Inst., Soesterberg, The Netherlands

Contract(s)/Grant(s): F41624-93-C-6001; Proj-7184

Report No.(s): AD-A408374; AFRL-HE-WP-TR-202-0173-VOL-2; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The Civilian American and European Surface Anthropometry Resource (CAESAR) project was a survey of the civilian populations of three countries representing the North Atlantic Treaty Organization (NATO) countries; the United States of America (USA), The Netherlands, and Italy. One site in Ottawa, Canada was added to the USA sample and it is henceforth referred to as the North American sample. The survey was carried out by the US Air Force, with the help of: 1) the contractor, Sytronics, Inc.; 2) The Netherlands Organization for Applied Scientific Research (TNO); and 3) a consortium of companies under the umbrella of the Society of Automotive Engineers (SAE). The purpose of this document is to provide a general description which contains descriptions of the methods used for the demographics, the measurements (both 3-D and 1-D), and the landmarks. It has a companion document.

DTIC

Anthropometry; Populations

20030005687 NASA Ames Research Center, Moffett Field, CA USA

Augmented Reality in a Simulated Tower Environment: Effect of Field of View on Aircraft Detection

Ellis, Stephen R., NASA Ames Research Center, USA; Adelstein, Bernard D., NASA Ames Research Center, USA; Reisman, Ronald J., NASA Ames Research Center, USA; Schmidt-Ott, Joelle R., San Jose State Univ., USA; Gips, Jonathan, San Jose State Univ., USA; Krozel, Jimmy, Seagull Technology, Inc., USA; September 2002; 50p; In English

Contract(s)/Grant(s): RTOP 771-51-12; RTOP 131-20-30; RTOP 548-51-12; RTOP 519-10-82

Report No.(s): NASA/TM-2002-211853; NAS 1.15:211853; IH-025; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An optical see-through, augmented reality display was used to study subjects' ability to detect aircraft maneuvering and landing at the Dallas Ft. Worth International airport in an ATC Tower simulation. Subjects monitored the traffic patterns as if from the airport's western control tower. Three binocular fields of view (14 deg, 28 deg and 47 deg) were studied in an independent groups' design to measure the degradation in detection performance associated with the visual field restrictions. In a second experiment the 14 deg and 28 deg fields were presented either with 46% binocular overlap or 100% overlap for separate groups. The near asymptotic results of the first experiment suggest that binocular fields of view much greater than 47% are unlikely to dramatically improve performance; and those of the second experiment suggest that partial binocular overlap is feasible for augmented reality displays such as may be used for ATC tower applications.

Author

Display Devices; Visual Fields; Field of View; Air Traffic Control

20030006750 Witwatersrand Univ., School of Mechanical, Industrial, and Aerospace Engineering, Johannesburg, South Africa

Pressure Amplification Due to Clothing *Final Report*

Bugarin, S.; Skews, B. W.; Jul. 2002; 106p; In English; Original contains color images

Contract(s)/Grant(s): N68171-01-M-5821

Report No.(s): AD-A408205; ARDSG-R/D-9096-MS-01; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Initial tests of shock wave impact on a surface covered with a layer of textile and positioned a short distance in front of it have shown that the pressure on the surface could be significantly higher than what would be experienced with no covering. The amplification of pressure is a function of textile type. It is suggested that the two mechanisms responsible for this effect are as follows: Firstly, on shock impact with the textile layer, part of the wave is reflected and part is transmitted. The transmitted wave then reflects off the underlying surface and part of this reflected wave is re-reflected back from the textile onto the surface raising the pressure further. A number of such reflections between the textile and the surface can raise the pressure further. Secondly, the textile layer is initially accelerated towards the wall, acting as a piston and pressurizing the gas in the gap through a compression wave. A comprehensive study of these effects is reported on, using a wide variety of textiles, both for single and multiple layers, and for head-on and inclined shock impact. Amplifications of up to 400 per cent have been recorded, and amplification variations with permeability, specific mass, and number of layers determined. Some tests with a 10 mm backing layer of gelatin have also been conducted in order to obtain information on pressure propagation into this simulated body tissue. Loads due to physical impact of the textile with the surface are not examined.

DTIC

Shock Waves; Protective Clothing

61

COMPUTER PROGRAMMING AND SOFTWARE

Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.

20030005102 RS Information Systems, Inc., Brook Park, OH USA

Firewall Traversal for CORBA Applications Using an Implementation of Bidirectional IIOP in MICO *Final Report*

Griffin, Robert L., RS Information Systems, Inc., USA; November 2002; 15p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS3-99175; RTOP 704-40-24

Report No.(s): NASA/CR-2002-211979; NAS 1.26:211979; E-13648; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Object Management Group (OMG) has added specifications to the General Inter-ORB Protocol (GIOP 1.2), specifically the Internet Inter-ORB Protocol (IIOP 1.2), that allow servers and clients on opposing sides of a firewall to reverse roles and still communicate freely. This addition to the GIOP specifications is referred to as Bidirectional GIOP. The implementation of these specifications as applied to communication over TCP/IP connections is referred to as 'Bidirectional Internet Inter-ORB Protocol' or BiDirIIOP. This paper details the implementation and testing of the BiDirIIOP Specification in an open source ORB, MICO, that did not previously support Bidirectional GIOP. It also provides simple contextual information and a description of the OMG GIOP/IIOP messaging protocols.

Author

Computer Networks; Architecture (Computers); Internets; Protocol (Computers); Computer Information Security; Operating Systems (Computers); Computer Systems Design

20030005498 Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

Standard CMMI Appraisal Method for Process Improvement (SCAMPI), Version 1. 1: Method Implementation Guidance for Government Source Selection and Contract Process Monitoring *Final Report*

Barbour, Rick; Benhoff, Melanie; Gallagher, Brian; Eslinger, Suellen; Bernard, Thomas; Sep. 2002; 437p; In English
Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A408309; CMU/SEI-2002-HB-002; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

Method implementation Guidance for Government Source Selection and Contract Process Monitoring provides guidance for use by Government personnel and their supporting organizations for fulfilling the objectives of the SCAMPI method in their acquisition environments. The Standard CMMI Appraisal Method for Process Improvement (SCAMPI) is designed to provide benchmark quality ratings relative to Capability Maturity Model Integration (CMMI) models. It is applicable to a wide range of appraisal USAge modes, including both internal process improvement and external capability determinations. SCAMP I satisfies all of the Appraisal Requirements for CMMI (ARC) requirements for a Class A appraisal method and can support the conduct of ISO/IEC 15504 assessments. The SCAMPI Method Definition Document describes the requirements, activities, and practices associated with each of the processes that compose the SCAMPI method. It is intended to be one of the elements of the infrastructure within which SCAMPI Lead Appraisers conduct a SCAMP I appraisal. Precise listings of required practices, parameters, and variation limits, as well as optional practices and guidance for enacting the method, are covered. An overview of the method's context, concepts, and architecture is also provided.

DTIC

Software Engineering; Contract Management

20030005691 Alabama Univ., Information Technology and Systems Center, Huntsville, AL USA

Earth Science Markup Language: Transitioning From Design to Application *Final Report, 15 May 2000 - 14 May 2002*

Moe, Karen, Alabama Univ., USA; Graves, Sara, Alabama Univ., USA; Ramachandran, Rahul, Alabama Univ., USA; Jun. 07, 2002; 7p; In English

Contract(s)/Grant(s): NAG5-9585; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The primary objective of the proposed Earth Science Markup Language (ESML) research is to transition from design to application. The resulting schema and prototype software will foster community acceptance for the "define once, use anywhere" concept central to ESML. Supporting goals include: 1. Refinement of the ESML schema and software libraries in cooperation with the user community. 2. Application of the ESML schema and software libraries to a variety of Earth science data sets and analysis tools. 3. Development of supporting prototype software for enhanced ease of use. 4. Cooperation with standards bodies in order to assure ESML is aligned with related metadata standards as appropriate. 5. Widespread publication of the ESML approach, schema, and software.

Author

Computer Programming; Data Management; Earth Sciences

20030005707 Garrett Turbine Engine Co., Phoenix, AZ USA

Transition Mixing Study *Final Report*

Reynolds, R., Garrett Turbine Engine Co., USA; White, C., Garrett Turbine Engine Co., USA; October 1986; 188p; In English
Contract(s)/Grant(s): NAS3-24340

Report No.(s): NASA-CR-175062; NAS 1.26:175062; GARRETT-21-5723; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

An analytic program has been conducted to develop a computer model capable of analyzing the flow field in the transition liner of small gas turbine engines. A FORTRAN code has been assembled from existing codes and physical submodels and used to predict the flow in several test geometries which contain characteristics similar to transition liners, and for which experimental data was available. Comparisons between the predictions and measurements indicate that the code produces qualitative results but that the turbulence models, both K-E and algebraic Reynolds Stress, underestimate the cross-stream diffusion. The code has also been used to perform a numerical experiment that examined the effect of a variety of parameters on the mixing process in transition liners. Comparisons between the different analyzed cases have illustrated that geometries with significant curvature show a drift of the jet trajectory toward the convex wall and weaker wake region vortices and decreased penetration for jets located on the convex wall of the liner, when compared to jets located on concave walls. Also shown were the approximate equivalency of angled slots and round holes and a technique by which jet mixing correlations developed for rectangular channels can be used for geometries.

Author

Flow Distribution; Fluid Jets; Computerized Simulation; Applications Programs (Computers); Turbulence Models

20030005737 Army Construction Engineering Research Lab., Champaign, IL USA

Conflict Management in Collaborative Engineering Design: Basic Research in Fundamental Theory, Modeling Framework, and Computer Support for Collaborative Engineering Activities *Final Report*

Lu, Stephen C-Y.; Udwadia, Firdaus; Cai, James; Burkett, William; Case, Michael P.; Jan. 2002; 176p; In English; Original contains color images

Report No.(s): AD-A408525; ERDC/CERL-TR-02-2; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

All real-world engineering tasks involve collaborative activities among a group of human participants. The ability to understand, support, and improve collaboration is a critical factor in determining the overall cost, time, and effectiveness of modern engineering activities. Collaborative engineering tools are being introduced into the market at a rate so high that it is difficult to infuse technology in a reasoned and effective manner. Practitioners must decide which tools to adopt and to develop new and more effective processes. These decisions are made even more difficult by the fact that no body of theory exists that has been shown to describe the interaction between complex object-oriented data models, engineering processes, and human decision making. The objective of this work was to develop the Theory for Collaboration in support of complex engineering system decisions in a highly distributed and heterogeneous environment. The results of this research will lead to a sound theoretical foundation that may be used to analytically and mathematically model, simulate, manage, and optimize collaborative engineering activities. Such a theory of collaboration will enable researchers to design, predict, and control various collaborative activities, systems, and environments, and to implement practical IT systems to support these important human endeavors.

DTIC

Decision Making; Computer Aided Design; Cost Effectiveness; Complex Systems

20030005738 Air Force Research Lab., Information Directorate, Rome, NY USA

Automatic Summarization with Sloth (Summarizes Lengthy Documents and Outputs The Highlights)

Kaplin, David B.; Nov. 2002; 19p; In English; Original contains color images

Contract(s)/Grant(s): AF Proj. 459E

Report No.(s): AD-A408523; AFRL-IF-RS-TM-2002-1; No Copyright; Avail: Defense Technical Information Center (DTIC)

SLOTH is an object-oriented, modular, text summarization tool written in the JAVA language. It uses the concept relationship information provided from textual analysis by the eQuery software developed at Syracuse University to create a summary of a text file using extracted sentences. SLOTH stands for Summarizes Lengthy documents and Outputs The Highlights.

DTIC

Computer Programs; Java (Programming Language); Object-Oriented Programming

20030005739 Air Force Research Lab., Information Directorate, Rome, NY USA

Intelligence Analyst Associate: Main Menu Development, Program Evaluation and Recommendations

Araki, Corrine; Nov. 2002; 31p; In English; Original contains color images

Contract(s)/Grant(s): AF Proj. 459E

Report No.(s): AD-A408522; AFRL-IF-RS-TM-2002-2; No Copyright; Avail: Defense Technical Information Center (DTIC)

The Intelligence Analyst Associate (IAA) is a software program developed under the sponsorship of AFRL to aid Intelligence Analysts in the task of deriving information from text documents. The primary goal of the project documented in this report was to design a new Main Menu for the IAA that is more intuitive and user friendly.

DTIC

Computer Programs; Intelligence; Texts

20030005927 Arca Systems, Inc., Santa Clara, CA USA

Multi-Domain Network Management Boundary Device *Final Report, Apr. 1998-Feb. 2002*

Markel, Herb; Jul. 2002; 89p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-C-0089; AF Proj. 7820

Report No.(s): AD-A408321; AFRL-IF-RS-TR-2002-167; No Copyright; Avail: Defense Technical Information Center (DTIC)

This report provides background information and conclusions for the Multi-Domain Network Management Boundary Device program. This development focused around providing a Network Common Operational Picture for a better ability to monitor diverse information enterprises composed of multiple compartmentalized networks.

DTIC

Management Information Systems; Computer Networks

20030005936 Pretoria Univ., South Africa

Controllable Wheeled Vehicle Suspension Research *Final Report*

Theron, N. J.; Els, P. S.; Aug. 2002; 54p; In English

Contract(s)/Grant(s): N6817101-M-5852

Report No.(s): AD-A408368; M0016; ERO-R/D-9086-AN-01S; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The classic compromise between wheeled vehicle ride comfort and handling is well known. For off-road vehicles (as used by the military), it is very difficult to achieve a good compromise due to the fact that these vehicles are also used on highways at high speeds. Controllable suspension systems offer the possibility to change the spring and damper characteristics while the vehicle is moving, thereby adapting to different terrains and speeds. This research involved the design, development, manufacturing, modeling and testing of a two-stage, semi-active, hydro-pneumatic spring, combined with a two stage semi-active damper. This system promises to improve both the ride comfort and handling (and therefore the mobility) of military wheeled vehicles. Test results indicate that the required characteristics can be achieved, and a design study proves the feasibility of fitting the system to a vehicle. It is concluded that the proposed suspension system is feasible and that further development of the system should continue.

DTIC

Suspension Systems (Vehicles); Military Vehicles

20030005946 Naval Air Systems Command, Training Systems Div., Orlando, FL USA

Research and Development Issues for Interactive Electronic Technical Manuals

Ricci, Katrina E.; Radtke, Paul H.; Hodak, John; Jul. 2002; 35p; In English; Original contains color images

Report No.(s): AD-A408390; NAVAIR/TSD-SR-2002-005; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Capable Manpower program of the Office of Naval Research's Future Naval Capabilities program is supporting research addressing the needs of the technical manual community. While there is a wide range of research issues associated with technical manuals, the focus of the Intelligent Performance Support and Training effort is the development and evaluation of various technologies to support Interactive Electronic Technical Manuals (IETMs). A workshop was conducted at the NAVAIR Orlando, Training Systems Division to discuss the domain and to present current research in this area. The purpose of this report is to document the proceedings of the workshop and further define the goals, technologies, and issues related to this research effort. Specific research areas include the use of device models and intelligent tutors, the application of Latent Semantic Analysis for search and navigation within an IETM, and spoken language interfaces and wearable computers to support hands-free use.

DTIC

Computer Assisted Instruction; Manuals

20030005952 Northeastern Univ., Boston, MA USA

Evolution of Software via Adaptive Programming *Final Report, Jun. 1996-Nov. 1999*

Lieberherr, Karl; Oct. 2002; 26p; In English

Contract(s)/Grant(s): F30602-96-2-0239; DARPA Order D886

Report No.(s): AD-A408399; AFRL-IF-RS-TR-2002-273; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Adaptive Programming (AP) is a technology that improves the separation of traversal-related concerns by separating the concerns of where-to-go, what-to-do and when-to-do. The three concerns can be understood using the terminology of Aspect-Oriented Programming (AOP): pointcuts, advice and introductions. The concern what-to-do can be implemented as an advice and concern when-to-do as a pointcut. The concern where-to-go specifies a set of introductions that implement a set of traversal methods. AP supports easy re-modularization of generic behavior that is formulated in terms of a generic class graph and traversal specifications (where-to-go concern) with respect to the class graph. Binding the generic behavior to a specific class graph involves updating the class graph and changing the traversal specifications, if needed. This high-level approach to re-modularization makes AP a useful tool to support software evolution.

DTIC

Software Engineering; Adaptive Control; Programming Languages; Object-Oriented Programming

20030006093 Teknowledge Federal Systems, Inc., Palo Alto, CA USA

Document Integrity through Mediated Interfaces

Tallis, Marcelo; Balzer, Robert; Jul. 14, 2001; 9p; In English

Contract(s)/Grant(s): F30602-99-1-0542

Report No.(s): AD-A408304; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

End-to-end integrity for documents is provided by wrapping the tools that manipulate those documents and mediating their operation to cryptographically integrity mark those documents as they are being saved, to check those documents are loaded, and to record an application-level history of the changes to the document. Corrupted documents (those failing to match their cryptographic integrity mark) are automatically repaired by replaying the recorded history of the application-level changes to the document. That recorded history is also used to identify all modifications (including date and author) to any selected portion of the document. A Document Integrity Manager embodying these capabilities has been developed for Microsoft Word.

DTIC

Computer Programs; Data Processing; Cryptography

20030006096 BAE Systems, Advanced Systems and Technology, Nashua, NH USA

Dynamic Reconfiguration for Adaptive Computing Systems (DRACS) Final Report, Jun. 1999-Mar. 2002

Zaino, John C.; Oct. 2002; 86p; In English; Original contains color images

Contract(s)/Grant(s): F30602-99-C-0164; ARPA Order J471; AF Proj. DRAC

Report No.(s): AD-A408401; AFRL-IF-RS-TR-2002-276; No Copyright; Avail: Defense Technical Information Center (DTIC)

The Dynamic Reconfiguration for Adaptive Computing Systems (DRACS) effort has exploited the emerging technology associated with run-time reconfigurable devices to develop system capabilities for run-time reconfiguration (RTR) of AGS hardware both in response to software control and in a data-driven manner. Using the DARPA-sponsored GSRG dynamically reconfigurable device, DRACS has demonstrated a host-driven design and reconfiguration as well as two data-driven designs, one Finite State Machine (FSM) driven and one additional host-driven demonstration. This report describes how these can be used to develop a "virtual co-processor" that supports multiple reconfigurable computing applications residing in a single piece of hardware. One demonstration focus selected involves a subset of a realistic system scenario for parameter measurement processing in electronic warfare that can be improved through the use of dynamic reconfiguration.

DTIC

Computer Systems Programs; Adaptive Control; Concurrent Engineering; Reconfigurable Hardware; Architecture (Computers)

20030006185 Space and Naval Warfare Systems Center, San Diego, CA USA

Advanced Propagation Model (APM) Ver. 1.3.1 Computer Software Configuration Item (CSCI) Documents Final Report

Barrios, A. E.; Patterson, W. L.; Aug. 2002; 480p; In English

Report No.(s): AD-A408521; SSC-TD-3145; No Copyright; Avail: CASI; A21, Hardcopy; A04, Microfiche

This document describes the Advanced Propagation Model (APM) Version 1.3.1 computer software configuration item (CSCI) design and provides an input software requirement overview, a CSCI design architecture overview, and a detailed design description of each CSCI component.

DTIC

Computer Programs; Software Engineering

20030006263 NASA Ames Research Center, Moffett Field, CA USA

Best Practices In Overset Grid Generation

Chan, William M., NASA Ames Research Center, USA; Gomez, Reynaldo J., III, NASA Johnson Space Center, USA; Rogers, Stuart E., NASA Ames Research Center, USA; Buning, Pieter G., NASA Langley Research Center, USA; [2002]; 24p; In English; 32nd AIAA Fluid Dynamics Conference, 24-27 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 755-50-11

Report No.(s): AIAA Paper 2002-3191; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Grid generation for overset grids on complex geometry can be divided into four main steps: geometry processing, surface grid generation, volume grid generation and domain connectivity. For each of these steps, the procedures currently practiced by experienced users are described. Typical problems encountered are also highlighted and discussed. Most of the guidelines are derived from experience on a variety of problems including space launch and return vehicles, subsonic transports with propulsion and high lift devices, supersonic vehicles, rotorcraft vehicles, and turbomachinery.

Author

Grid Generation (Mathematics); Computational Grids

20030006290 Illinois Univ., Grants and Contracts Administration, Champaign, IL USA

High Performance Virtual Machines Final Report, Aug. 2000-Oct. 2001

Chien, Andrew A.; Jul. 2002; 14p; In English

Contract(s)/Grant(s): F30602-96-1-0286; ARPA ORDER-J089; AF Pro. D985

Report No.(s): AD-A408475; GCC0Q387; AFRL-IF-RS-TR-2002-156; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary goal of the High Performance Virtual Machines (HPVM) project was to reduce the effort required to build a high performance cluster and distributed applications by leveraging the investments and understanding of scalable parallel systems. The approach to reducing the programming effort required to build high performance distributed applications was to insulate the program with a uniform, portable abstraction - a High Performance Virtual Machine - with predictable, high performance characteristics. Success was achieved by delivering a large fraction of the underlying hardware performance, visualizing resources to provide portability and reduce the application building effort and delivering predictable, high performance computing. HPVM has produced several major software releases involving high performance communication libraries, complete cluster software systems, and improved versions of those systems on a variety of hardware and software platforms. These systems have been downloaded and deployed at top research universities, major computer companies and national research laboratories. Clusters of commodity systems connected by high-speed networks are an important computing element and serve as an important model for future computing environments. Technologies which effectively exploit distributed computational resources can tap this "cluster pool" to deliver high performance computing, dramatically increasing the computational power available for both high performance computing and high performance distributed applications.

DTIC

Computer Programs; Computer Networks

20030006292 Protobox, LLC, Fairborn, OH USA

An Embedded Simulator Test Evaluation Monitor (ESTEEM) to Improve Distributed Mission Training Final Report, Mar. 2001-Feb. 2002

Ewart, Ronald B.; Slutz, Gary J.; Sep. 2002; 42p; In English; Original contains color images

Contract(s)/Grant(s): F33615-01-M-6049; AF Proj. 3005

Report No.(s): AD-A408463; AFRL-HE-AZ-TR-2002-0066; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Embedded Simulator Test Evaluation Monitor (ESTEEM) is an innovative network simulation performance monitoring system that will enable researchers to understand and quantify the performance of simulation while it is being conducted. ESTEEM will measure simulation latencies and accuracies, identify and pinpoint sources of problems, provide status and entity information, and immediately display information to the researcher. ESTEEM is based on a multiprocessor computer running the Linux Operating System with a real-time extension incorporated to provide deterministic performance. A global positioning system (GPS) capability provides accurate time-stamping of each piece of data and correlation of data gathered at multiple simulation nodes. A variety of data-gathering subsystems enables ESTEEM to measure simulator signals. The system will enable researchers to conduct experiments evaluating the interactive performance of network simulations, human pilots, and simulation participants.

DTIC

Simulation; Education; Human Performance; Monitors

20030006327 University of Southern California, Information Sciences Inst., Marina del Rey, CA USA

Teamcore Project Control of Agent-Based Systems (COABS) Program Final Report, May 1998-May 2002

Tambe, Milind; Sep. 2002; 40p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-2-0108; DARPA ORDER-G335; AF Proj. AGEN

Report No.(s): AD-A408273; AFRL-IF-RS-TR-2002-253; No Copyright; Avail: Defense Technical Information Center (DTIC)

An increasing number of agent-based systems now operate in complex dynamic environments, such as disaster rescue missions, monitoring/surveillance tasks, enterprise integration, and education/training environments. With this increasing population of available agents, we can expect another powerful trend: the reuse of specialized agents as standardized building blocks for large-scale systems. System designers can integrate these existing agents to construct new multi-agent systems capable of solving problems of greater complexity than those addressed by the individual agents themselves. Integrating agents to perform real-world tasks in a large-scale system remains difficult. As part of DARPA's Control of Agent-Based Systems (CoABS) program, the Teamcore project addressed this challenge of agent integration by focusing on general-purpose teamwork capabilities. Based on successful applications of teamwork to closed multiagent systems, the key hypothesis behind Teamcore is that teamwork among agents can enhance robust execution even among heterogeneous agents in an open environment. No

matter how diverse the agents may be, if they act as team members, then we can expect them to act responsibility towards each other, to cover for each other's execution failures, and to exchange key information. This report describes key contributions of the Teamcore project in areas of teamwork theory, team monitoring, adjustable autonomy and team oriented programming.

DTIC

Computer Programs; Autonomy; Education; Surveillance

20030006676 NASA Langley Research Center, Hampton, VA USA

Effect of Random Geometric Uncertainty on the Computational Design of a 3-D Flexible Wing

Gumbert, C. R., NASA Langley Research Center, USA; Newman, P. A., NASA Langley Research Center, USA; Hou, G. J.-W., Old Dominion Univ., USA; [2002]; 7p; In English; 20th AIAA Applied Aerodynamics Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS1-19858; NASA Order L-9291

Report No.(s): AIAA Paper 2002-2806; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The effect of geometric uncertainty due to statistically independent, random, normally distributed shape parameters is demonstrated in the computational design of a 3-D flexible wing. A first-order second-moment statistical approximation method is used to propagate the assumed input uncertainty through coupled Euler CFD aerodynamic / finite element structural codes for both analysis and sensitivity analysis. First-order sensitivity derivatives obtained by automatic differentiation are used in the input uncertainty propagation. These propagated uncertainties are then used to perform a robust design of a simple 3-D flexible wing at supercritical flow conditions. The effect of the random input uncertainties is shown by comparison with conventional deterministic design results. Sample results are shown for wing planform, airfoil section, and structural sizing variables.

Author

Statistical Analysis; Shapes; Flexible Wings; Computational Fluid Dynamics; Airfoil Profiles; Three Dimensional Models

20030006686 NASA Langley Research Center, Hampton, VA USA

System IDentification Programs for AirCRAFT (SIDPAC)

Morelli, Eugene A., NASA Langley Research Center, USA; [2002]; 19p; In English; AIAA Atmospheric Flight Mechanics Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4704; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

A collection of computer programs for aircraft system identification is described and demonstrated. The programs, collectively called System IDentification Programs for AirCRAFT, or SIDPAC, were developed in MATLAB as m-file functions. SIDPAC has been used successfully at NASA Langley Research Center with data from many different flight test programs and wind tunnel experiments. SIDPAC includes routines for experiment design, data conditioning, data compatibility analysis, model structure determination, equation-error and output-error parameter estimation in both the time and frequency domains, real-time and recursive parameter estimation, low order equivalent system identification, estimated parameter error calculation, linear and nonlinear simulation, plotting, and 3-D visualization. An overview of SIDPAC capabilities is provided, along with a demonstration of the use of SIDPAC with real flight test data from the NASA Glenn Twin Otter aircraft. The SIDPAC software is available without charge to U.S. citizens by request to the author, contingent on the requestor completing a NASA software USAge agreement.

Author

Computer Programs; Data Processing; Errors; Estimating; Experiment Design; System Identification

20030006688 Notre Dame Univ., Dept. of Aerospace and Mechanical Engineering, IN USA

Advanced Information Technology in Simulation Based Life Cycle Design, 1 Oct. 1999 - 30 Sep. 2002

Renaud, John E., Notre Dame Univ., USA; [2003]; 19p; In English

Contract(s)/Grant(s): NAG1-2240; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this research a Collaborative Optimization (CO) approach for multidisciplinary systems design is used to develop a decision based design framework for non-deterministic optimization. to date CO strategies have been developed for use in application to deterministic systems design problems. In this research the decision based design (DBD) framework proposed by Hazelrigg is modified for use in a collaborative optimization framework. The Hazelrigg framework as originally proposed provides a single level optimization strategy that combines engineering decisions with business decisions in a single level optimization. by transforming this framework for use in collaborative optimization one can decompose the business and

engineering decision making processes. In the new multilevel framework of Decision Based Collaborative Optimization (DBCO) the business decisions are made at the system level. These business decisions result in a set of engineering performance targets that disciplinary engineering design teams seek to satisfy as part of subspace optimizations. The Decision Based Collaborative Optimization framework more accurately models the existing relationship between business and engineering in multidisciplinary systems design.

Author

Systems Engineering; Simulation; Design Optimization; Design Analysis

20030006741 Medsn, Culver City, CA USA

Implementing Adaptive Technology and Supplemental Curriculum for Anatomy and Physiology

Sahota, Bill; Nagarathnam, Sundar; Mathur, Tarun; Oct. 25, 2002; 41p; In English; Original contains color images

Contract(s)/Grant(s): USZA22-01-C-0024; OSD00-CR09 PHASE 2

Report No.(s): AD-A408183; V1; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document is focused on describing how, technically, implementing adaptive technology and supplemental curriculum for Anatomy and Physiology is developed from a functional use aspect including Functionality Use Case Scenarios, Technical Architecture Overview, Medsn Learning Object (MLO) Details, E-Learning Path (ELP) Details and SCORM Implementation. DTIC

Computer Programs; Software Engineering

62

COMPUTER SYSTEMS

Includes computer networks and distributed processing systems. For information systems see 82 Documentation and Information Science. For computer systems applied to specific applications, see the associated category.

20030005497 Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA

SARA: Survivable Autonomic Response Architecture

Lewandowsky, Scott M.; Van Hook, Daniel J.; O'Leary, Gerald C.; Haines, Joshua W.; Rossey, Lee M.; Mar. 23, 2001; 13p; In English

Contract(s)/Grant(s): F19628-00-C-0002

Report No.(s): AD-A408307; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper describes the architecture of a system being developed to defend information systems using coordinated autonomic responses. The system will also be used to test the hypothesis that an effective defense against fast, distributed information attacks requires rapid, coordinated, network-wide responses. The core components of the architecture are a run-time infrastructure (RTI), a communication language, a system model, and defensive components. The RTI incorporates a number of innovative design concepts and provides fast, reliable, exploitation-resistant communication and coordination services to the components defending the network, even when challenged by a distributed attack. The architecture can be tailored to provide scalable information assurance defenses for large, geographically distribute, heterogeneous networks with multiple domains, each of which uses different technologies and requires different policies. The architecture can form the basis of a field-deployable system. An initial version is being developed for evaluation in a testbed that will be used to test the autonomic coordination and response hypothesis.

DTIC

Architecture (Computers); Information Systems; Computer Information Security; Autonomy

20030005760 Naval Postgraduate School, Monterey, CA USA

Diamond HASP Trusted Computing Exemplar

Irvine, Cynthia E.; Levin, Timothy E.; Dinolt, George W.; Sep. 2002; 14p; In English

Report No.(s): AD-A408429; NPS-CS-02-004; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Information Infrastructure is weak; there are no high security, high assurance, off-the-shelf products available that can be used to strengthen it; and the National capability to design and construct such trusted computer systems and networks has atrophied. The purpose of the Trusted Computing Exemplar project is to provide a worked example to show how trusted computing systems and components can be constructed. A prototype high assurance development framework will be created first, and then used to produce a reference implementation trusted computing component the Embedded MicroKernel Prototype. A third-party evaluation of the component will be initiated during development (e.g., once the high-level design documentation is

written). The documentation, source code, development framework and other deliverables will be made openly available as they are produced. We will develop a high assurance, embedded micro-kernel and a trusted application built on top of the micro-kernel as a reference implementation exemplar for trusted computing. Because the product as well as the process will be showpieces for trusted computing development, high assurance methodologies and techniques will be applied during the entire lifecycle. The goal is to produce a very small, portable component that will provide users with correct security operation and an a priori assurance against system subversion.

DTIC

Computer Networks; Data Processing; Prototypes; Computer Information Security

20030005762 National Inst. of Standards and Technology, Gaithersburg, MD USA

CBEFF Common Biometric Exchange File Format

Podio, Fernando L.; Dunn, Jeffrey S.; Reinert, Lawrence; Tilton, Catherine J.; O’Gorman, Lawrence; Jan. 03, 2001; 38p; In English

Report No.(s): AD-A408418; NISTIR 6529; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Common Biometric Exchange File Format (CBEFF) describes a set of data elements necessary to support biometric technologies in a common way. These data can be placed in a single file used to exchange biometric information between different system components or between system. The result promotes interoperability of biometric-based application programs and systems developed by different vendors by allowing biometric data interchange. CBEFF’s initial conceptual definition was achieved through a series of three Workshops co-sponsored by the National Institute of Standards and Technology and the Biometric Consortium. A Technical Development Team, formed as a result of these Workshops, developed CBEFF, as described in this publication, in coordination with industrial organizations (i.e., the BioAPI Consortium, the X9.F4 Working Group, the International Biometric Industry Association, and the Interfaces Group of TeleTrusT) and end users. CBEFF provides forward compatibility accommodating for technology improvements and allows for new formats to be created. CBEFF implementations simplify integration of software and hardware provided by different vendors. Further development (e.g., a CBEFF smart card format) is proposed under the umbrella of the recently formed Biometrics Interoperability, Performance, and Assurance Working Group co-sponsored by MST and the Biometric Consortium.

DTIC

Biometrics; Format; File Maintenance (Computers); Computer Systems Design; Information Transfer

20030005806 NASA Langley Research Center, Hampton, VA USA

Using the Web for Competitive Intelligence (CI) Gathering

Rocker, JoAnne, NASA Langley Research Center, USA; Roncaglia, George, NASA Langley Research Center, USA; [2002]; 6p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0282; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

Businesses use the Internet as a way to communicate company information as a way of engaging their customers. As the use of the Web for business transactions and advertising grows, so too, does the amount of useful information for practitioners of competitive intelligence (CI). CI is the legal and ethical practice of information gathering about competitors and the marketplace. Information sources like company webpages, online newspapers and news organizations, electronic journal articles and reports, and Internet search engines allow CI practitioners analyze company strengths and weaknesses for their customers. More company and marketplace information than ever is available on the Internet and a lot of it is free. Companies should view the Web not only as a business tool but also as a source of competitive intelligence. In a highly competitive marketplace can any organization afford to ignore information about the other players and customers in that same marketplace?

Author

Information Retrieval; Intelligence; Information Systems

20030005808 NASA Langley Research Center, Hampton, VA USA

The Development and Evaluation of an Operational Aerobraking Strategy for the Mars 2001 Odyssey Orbiter

Tartabini, Paul V., NASA Langley Research Center, USA; Munk, Michelle M., NASA Langley Research Center, USA; Powell, Richard W., NASA Langley Research Center, USA; [2002]; 21p; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4537; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

The Mars 2001 Odyssey Orbiter successfully completed the aerobraking phase of its mission on January 11, 2002. This paper discusses the support provided by NASA's Langley Research Center to the navigation team at the Jet Propulsion Laboratory in the planning and operational support of Mars Odyssey Aerobraking. Specifically, the development of a three-degree-of-freedom aerobraking trajectory simulation and its application to pre-flight planning activities as well as operations is described. The importance of running the simulation in a Monte Carlo fashion to capture the effects of mission and atmospheric uncertainties is demonstrated, and the utility of including predictive logic within the simulation that could mimic operational maneuver decision-making is shown. A description is also provided of how the simulation was adapted to support flight operations as both a validation and risk reduction tool and as a means of obtaining a statistical basis for maneuver strategy decisions. This latter application was the first use of Monte Carlo trajectory analysis in an aerobraking mission.

Author

Aerobraking; Capture Effect; Flight Operations; Navigation; Planning; Simulation; Trajectories

20030005948 Boeing Phantom Works, Seattle, WA USA

Automatic Response to Intrusion Final Report, Mar. 1997-Aug. 2002

Schnackenberg, Dan; Holliday, Harley; Reid, Travis; Bunn, Kelly; Sterne, Dan; Oct. 2002; 39p; In English

Contract(s)/Grant(s): F30602-97-C-0309; AF Proj. F025

Report No.(s): AD-A408394; AFRL-IF-RS-TR-2002-288; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This contract final technical report documents the Automated Response to Intrusion project results. This project extended concepts developed in the Dynamic Cooperating Boundary Controllers project, which developed the initial version of the Intruder Detection and Isolation Protocol (IDIP). IDIP provides an infrastructure for intruder tracking and containment. The focus of the extensions developed under the Automated Response to Intrusions project was to integrate the IDIP technology with selected security technologies to improve the effectiveness of the intrusion response system. This work also leveraged results from the Adaptive System Security Policies contract. This report provides an overview of the current IDIP implementation and the results of this contract. It also provides references to IDIP documentation and technical papers where more detail can be found on the IDIP implementation and architecture.

DTIC

Automatic Control; Detection; Computer Information Security; Protocol (Computers)

20030006092 Network Associates Technology, Inc., Los Angeles, CA USA

Countermeasure Characterizations. Building Blocks for Designing Secure Information Systems

Lubbes, Herman O.; Jun. 14, 2001; 14p; In English

Contract(s)/Grant(s): F30602-98-C-0012

Report No.(s): AD-A408303; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Assurance Working Group (AWG) within the IA Program studied a number of issues relating to the design end analysis of secure systems. A principal element of this work was to understand how to select and integrate countermeasures to form secure systems. It was found that one of the biggest failures of the existing design process was that there was a lack of information about what countermeasures did, how they did it, and how they depended on their operational environment. The Common Criteria documentation provided this information, but the documentation was formal and voluminous. A number of factors led the AWG to adapt an abbreviated format and data description referred to as the Countermeasure Characterization (CMC) containing much of the same information required by the Common Criteria. The countermeasure documentation resulting from the application of CMC data description and format not only supports the system designer, but the thought process necessary to produce it gives the countermeasure developer a better understanding of the environment in which the product must operate.

DTIC

Information Systems; Ceramic Matrix Composites; Design Analysis

20030006258 Academy of Sciences (Russia), Inst. of Information Science and Automation, Saint Petersburg, Russia

Agent-Based Model of Information Security System: Architecture and Formal Framework for Coordinated Intelligent Agents Behavior Specification Final Report, 12 Jan. 1999-1 Mar. 2001

Gorodetski, Vladimir; Mar. 21, 2001; 60p; In English; Original contains color images

Report No.(s): AD-A408246; EOARD-ISTC-99-7001; No Copyright; Avail: Defense Technical Information Center (DTIC)

The contractor will research and further develop the technology supporting an agent-based architecture for an information security system and a formal framework to specify a model of distributed knowledge. This research will include a comparative

analysis of existing steganography & steganoanalysis techniques and the development and mathematical justification of an alternative approach to be incorporated in the proposed architecture.

DTIC

Data Processing; Security; Warning Systems

20030006271 Massachusetts Inst. of Tech., Artificial Intelligence Lab., Cambridge, MA USA

Ensuring Survivable Information Services: Architecting, Diagnosing and Reconfiguring *Final Report, Jan. 1998-Dec. 1999*

Shrobe, Howard; Oct. 2002; 36p; In English

Contract(s)/Grant(s): F30602-98-1-0067; AF Proj. F250

Report No.(s): AD-A408505; AFRL-IF-RS-TR-2002-285; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The central premise of this work is that a significant shift of focus and approach is necessary in order to deal with the emerging threat of information attacks on the critical infrastructures of our society. A range of studies, for example those conducted by the RAND Corporation and by a DARPA ISAT project, raised the concern that a concerted information attack by a skillful and motivated opponent could lead to catastrophic consequences. In particular, it was observed that the increasing reliance by the Department of Defense on advanced information technologies made it particularly vulnerable to such attacks. Information attacks have few physical warning signs, are often extremely difficult to detect, are difficult to distinguish from normal malfunctions, and are capable of interfering with or totally disabling complex military operations. Finally, it was observed that traditional security techniques only address part of the problem; they attempt to prevent attacks, but they offer little once an attack has been successfully launched.

DTIC

Military Operations; Computer Information Security

20030006272 Odyssey Research Associates, Inc., Ithaca, NY USA

Information Tools for Security Protection *Final Report, Apr. 1996-Aug. 1997*

Rosenthal, David; Samsel, Peter; Barbasch, Cheryl; Nov. 2002; 25p; In English

Contract(s)/Grant(s): F30602-96-C-0091; AF Proj. 7820

Report No.(s): AD-A408503; AFRL-IF-RS-TR-2002-280; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes the three tools built for the Information Security Tools project. Each of these tools provides a way of helping a user uncover potential security problems arising from the composition of parts of a system. The intent of this work was to provide tools USABLE by trained, but not necessarily expert, security personnel. The System Security Analysis Tool helps a user to model and analyze the security of systems. It provides a way to combine a security analysis of a generic architecture with the specific requirements of a particular system. The Application System Call Analysis Tool is used to identify a trusted application's system calls, and display potential problems or limitations associated with those calls. It is intended for use with an HP-CMW. The Application Installation Analysis Tool is used to check the access-control policy of a trusted application on an HP-CMW using a vendor's abstract policy, installation parameters, and the current state of the system. It provides a way of identifying differences between the way an access control policy is implemented and the vendor's policy.

DTIC

Computer Information Security; Applications Programs (Computers)

20030006281 Utica Coll., NY USA

Cyber-Forensic Research Experimentation and Test Environment (CREATE) *Final Report, Feb. 2001-Feb 2002*

Gorden, Gary R.; Hosmer, Chester D.; Oct. 2002; 112p; In English; Original contains color images

Contract(s)/Grant(s): F30602-01-1-0506; AF Proj. 01PG

Report No.(s): AD-A408491; AFRL-IF-RS-TR-2002-269; No Copyright; Avail: Defense Technical Information Center (DTIC)

The objective of this effort was to develop methodologies and standards for cyber forensics methods and tools. The current cyber forensic certification/ validation efforts are described along with a best practices model. The potential for an Information Analysis Center (IAC) in computer forensics was explored. Finally, the International Journal of Digital Evidence, an online journal, was established to report the research findings in these areas as well as other cyber forensics research.

DTIC

Digital Systems; Computer Information Security

20030006282 Virginia Univ., Dept. of Computer Science, Charlottesville, VA USA

Survivability Architectures Final Report, Oct. 1996-May 2000

Knight, John C.; Oct. 2002; 167p; In English

Contract(s)/Grant(s): F30602-96-1-0314; AF Proj. E017

Report No.(s): AD-A408490; AFRL-IF-RS-TR-2002-267; No Copyright; Avail: CASI; A02, Microfiche; A08, Hardcopy

Many large information systems have evolved to a point where organizations rely heavily upon them. In some cases, such systems are so widespread and so important that the normal activities of society depend upon their continued operations. Management of transportation systems such as air traffic control, telecommunications, nationwide control of power distribution, and the financial system are examples. Military information systems are similar in that many military functions are dependent on large information systems, and the ability of the Department of Defense to use its resources effectively is contingent on the proper operation of these information systems. Such systems, both civilian and military, are referred to as critical information systems. Improving the survivability of critical information systems is essential for both civilian and military applications. The way in which this is done is to implement a monitoring and control structure known as a survivability mechanism that operates separately from the information system itself. The survivability mechanism is responsible for detecting faults and recovering from them. Important issues that arise from this approach are fast and flexible reconfiguration of the application when faults occur and protection of the survivability mechanism against security attacks.

DTIC

Information Systems; Computer Information Security

20030006285 Massachusetts Inst. of Tech., Cambridge, MA USA

Malleable Caches Final Report, May 1999-Sep. 2001

Devadas, Srin; Rudolph, Larry; Nov. 2002; 57p; In English; Original contains color images

Contract(s)/Grant(s): F30602-99-2-0511; AF Proj. HPSW

Report No.(s): AD-A408487; AFRL-IF-RS-TR-2002-296; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Managing the memory hierarchy is important for providing good performance of data intensive computation. This effort has explored several techniques for managing the cache in a microprocessor. This report examines column caching, cache partitioning, and cache compression techniques, especially in regards to the Data Intensive System (DIS) benchmarks. As a result of this study it was found that compression can be added to caches to improve capacity, but creates problems of replacement strategy and fragmentation. These problems can be solved using partitioning. A dictionary-based compression scheme allows for reasonable compression and decompression latencies and compression ratios. Keeping the data in the dictionary from becoming stale can be avoided with a clock scheme. The performance gains of a PCC over a standard cache of equivalent size can be attributed to two factors. A PCC potentially stores more data than a standard cache, which can reduce capacity misses and a PCC has more associativity than a standard cache of equivalent size, which can reduce conflict misses. Various techniques can be used to reduce the latency involved in the compression and decompression process. Searching on part of the dictionary during compression, using multiple banks or CAMs to examine multiple dictionary entries simultaneously, and compressing a cache line starting at different points in parallel can reduce compression latency. Finally, there are many different compression schemes some of which may perform better or be easier to implement in hardware.

DTIC

Computer Programs; Architecture (Computers)

20030006330 Honeywell, Inc., Minneapolis, MN USA

Shared Human Computer Interaction Environment Final Report, Jun. 1995-Mar. 1999

Nelson, Kyle S.; Penner, Robin R.; Steinmetz, Erik S.; Whitlow, Stephen D.; Sep. 2002; 43p; In English; Original contains color images

Contract(s)/Grant(s): F30602-95-C-0177; DARPA ORDER-8137; Proj-C505

Report No.(s): AD-A408267; AFRL-IF-RS-TR-2002-231; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Shared Human Computer Interaction Environment program is described with explored collaboration between humans and software agents operating in information-intensive, dynamic command and control applications. Combat search and rescue (CSAR) was the specific domain within which this research was conducted. Over the course of the three-year project, experts from numerous civilian and military organizations contributed to a detailed understanding of CSAR operations that influenced the vision, design, and implementation of the resulting system, the Search and Rescue Assistant (SARA). Expert review indicated that, when implemented SARA would provide order of magnitude improvements to CSAR operations.

DTIC

Human-Computer Interface; Computer Programs; Dynamic Control; Command and Control

20030006469 Odyssey Research Associates, Inc., Ithaca, NY USA

Scalable Intrusion Detection and Response Framework *Final Report, Apr. 1997-Apr 1999*

Reilly, Mark E.; Oct. 2002; 42p; In English; Original contains color images

Contract(s)/Grant(s): F30602-97-C-0140; AF Proj. 2301

Report No.(s): AD-A408445; AFRL-IF-RS-TR-2002-281; No Copyright; Avail: Defense Technical Information Center (DTIC)

This effort developed a prototype scalable intrusion detection and response framework that hosts a set of intrusion detection and response technologies that demonstrate scalability in a high-assurance environment and ease of deployment as well as overcoming some of the limitations of traditional intrusion detection systems. This environment allows a developer to build an intrusion detection system without having to be concerned about the low-level, system-dependent details such as how to access built-in operating systems and hardware security functions, how to make a process on one computer communicate to a process on another computer, how to deploy an intrusion detection system, etc. This SIDF framework provides an open environment that sustains a wide variety of intrusion detection agents. The open architecture of this framework allows for a varying set of agents to be developed by a wide range of organizations.

DTIC

Detection; Software Engineering; Computer Information Security; Prototypes

20030006470 Telcordia Technologies, Inc., Morristown, NJ USA

Independent Monitoring for Network Survivability *Final Report, Mar. 1997-Aug. 2002*

Oct. 2002; 106p; In English

Contract(s)/Grant(s): F30602-97-C-0188; AF Proj. F253

Report No.(s): AD-A408446; AFRL-IF-RS-TR-2002-284; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This project addresses the problem of inferential topology discovery and network performance assessment. Specifically, we invent and analyze algorithms to deduce a network's internal topological structure and performance from delay and loss data based on packets exchanged among a set of monitors. The method assumes independent of network management, i.e., with no querying of routers or routing protocol data. This is a new and deep research area, especially difficult because, as we show, end-to-end measurement data is fundamentally under-determined to solve for the network topology (in straightforward manner). Among our methods, we have several negative results, and some successes, that make significant progress toward a general solution. A prototype monitoring system has been constructed and used to collect network data. The measurement technique is "sparse active monitoring" where monitors create their own traffic, but at a very low level. We address related issues of the monitor design, data collection and storage, web-based graphical user interface for analysis, and rendering of network maps. We found that our monitors were not sufficiently well synchronized to make accurate one-way delay measurements, and we discuss a method for correcting the delay data for clock drift.

DTIC

Topology; Computer Networks; Systems Integration; Monitors; Algorithms; Computer Information Security

20030006700 Sandia National Labs., Albuquerque, NM USA

Agent-Based Mediation and Cooperative Information Systems

Phillips, L. R.; Link, H. E.; Goldsmith, S. Y.; Jun. 2002; 126p; In English

Report No.(s): DE2002-800991; SAND2002-1760; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report describes the results of research and development in the area of communication among disparate species of software agents. The two primary elements of the work are the formation of ontologies for use by software agents and the means by which software agents are instructed to carry out complex tasks that require interaction with other agents. This work was grounded in the areas of commercial transport and cybersecurity.

NTIS

Information Systems; Research and Development; Computer Information Security

CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS

Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also 54 Man/System Technology and Life Support.

20030005510 Army Research Inst. for the Behavioral and Social Sciences, Alexandria, VA USA

Gesture Recognition System for Hand and Arm Signals *Final Report, Jul. 2001-Jun. 2002*

Lampton, Donald R.; Knerr, Bruce W.; Clark, Bryan R.; Martin, Glenn A.; Washburn, Donald A.; Nov. 2002; 23p; In English
Report No.(s): AD-A408459; ARI-RN-2003-06; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes an evaluation of a computer system for recognizing human hand and arm signals as a means of interacting with virtual environments. The system consists of two video cameras, software to track the positions of the gesturer's head and hands, and software to recognize gestures by analyzing the position and movement of the hands. The software was hosted on a standard PC. A set of 14 gestures from Army Field Manual 21-60, Visual Signals, was used to test the system. Ten participants individually performed each gesture twice as discrete trials, with a brief rest period between each trial. The average recognition rate was 68%. The highest average recognition rate for an individual was 86%; the lowest was 57%. Three of the 14 gestures were always recognized correctly, and one was never recognized correctly. While no tracking failures occurred for four of the gestures, tracking failures ranged from 10% to 100% for the other ten. The system's capabilities for untagged optical tracking and recognition of gestures involving certain types of repetitive motion advance the state-of-the-art in computer-based gesture recognition. However, for training applications, substantial improvements are needed in tracking reliability and recognition of gestures involving the depth dimension.

DTIC

Pattern Recognition; Virtual Reality; Applications Programs (Computers); Hand (Anatomy); Arm (Anatomy)

20030005520 Air Force Research Lab., Air Vehicles Directorate, Wright-Patterson AFB, OH USA

A Method for the Determination of the Attainable Moment Set for Non-Linear Control Effectors

Bolender, Michael A.; Doman, David B.; Oct. 2002; 11p; In English

Report No.(s): AD-A408535; AFRL-VA-WP-TP-2002-326; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A method for generating the attainable moment set for a class of multiple non-linear control effectors is presented. The Jacobian Rank Deficiency Criteria from Swept Volume Theory is used to determine a set of control effector positions that in turn determine a set of candidate surfaces that comprise the boundary of the attainable moment set. The first order necessary conditions are derived for a point to be on the boundary by considering a non-linear programming problem. An algorithm is given where the Kuhn-Tucker points for a given point in the pitch-roll plane are constructed for each control effector configuration that forms a candidate boundary. The Kuhn-Tucker points are then checked for feasibility, and the points on the boundary are the ones that maximize and minimize the objective function. This method is computationally efficient in spite the fact that a large set of points in is searched since the evaluation of the Kuhn-Tucker points is straight forward and less computationally intensive than those methods which require an exhaustive search over every point on each candidate surface.

DTIC

Nonlinear Systems; Control Equipment; Algorithms

20030005657 University of Southern California, Information Sciences Inst., Marina del Rey, CA USA

Ontologies, Knowledge Bases and Knowledge Management *Final Report, Apr. 1997-Jan. 2001*

Chalupsky, Hans; MacGregor, Robert M.; Jul. 2002; 78p; In English

Contract(s)/Grant(s): F30602-97-C-0068; AF Proj. E949

Report No.(s): AD-A408551; AFRL-IF-RS-TR-2002-163; No Copyright; Avail: Defense Technical Information Center (DTIC)

This report describes: (1) the process of building, using and reusing the JFACC ontology for the domain of air campaign planning, and (2) an application called Strategy Development Assistant (SDA) that uses that ontology. The JFACC ontology served as a basis for knowledge sharing among several applications in the domain of air campaign planning. We describe how the ontology was built, how several applications made use of it as well as issues and lessons learned. The Strategy Development Assistant is a knowledge-based, mixed-initiative planning system to support air campaign planning. It supports military planners to decompose high-level objectives into move specific sub-objectives. The choice of decomposition is template driven based on a theory of air campaign planning provided by a domain expert. Since the SDA keeps the human in the loop, it can assist military planners while still giving them full control over each step in a very complex decision making process.

DTIC

Knowledge Based Systems; Decomposition

20030005676 Pavia Univ., Italy

Design, Development and Testing of Vision Algorithms for the Detection of Human Shapes *Final Report, 14 Jun. 2001-13 Jun 2002*

Bertozzi, Massimo; Broggi, Alberto; Fascioli, Alessandra; Lombardi, Paolo; Tibaldi, Amos; Jul. 25, 2002; 71p; In English
Contract(s)/Grant(s): N68171-01-M-5875

Report No.(s): AD-A408135; R/D-9095-AN-015; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report presents the research work developed under contract number N68171-01-M-5875 with the aim of localizing human shapes in day-light images. First an outlook of the problem is given, along with the description of the chosen approach and motivation, then the schedule of the activities performed during the research period is presented. The main part of this report is centered on the description of the algorithm developed. A final section discusses the results obtained in different conditions and scenarios, giving the qualitative and quantitative performance achieved on sample sequence of images. The publications resulting from this research are also included.

DTIC

Algorithms; Detection; Computer Vision; Shapes

20030005714 Florida International Univ., Dept. of Mechanical Engineering, Miami, FL USA

Design and Construction of a Portable Force-Reflecting Manual Controller for Teleoperation Systems *Final Report, Jan. 1997-Jan 1998*

Batsomboon, Pat; Tosunoglu, Sabri; Repperger, Daniel W.; Jan. 1998; 157p; In English
Contract(s)/Grant(s): Proj-7184

Report No.(s): AD-A408120; AFRL-HE-WP-TR-2002-0175; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

A teleoperation system was constructed to work in uncertain, complex, and hazardous environments. The remote operator who controls this system is located at a safe venue and receives video information and also has access to a force reflecting robotic manipulator. The force reflecting robotic manipulator (manipulandum) provides a sense of telesensation to the operator, thus enhancing his situational awareness about the remote task being performed. Various controllers were used to assist the operator in the performance of the task in the remote environment, including fuzzy logic controllers and PID (proportional, integral, derivative) controllers. A GUI (graphical user interface) was built and integrated into this system and has many useful attributes including position scaling, force scaling, rereferencing, etc. which enables the system to work in various task paradigms including teach pendant operation as well as for manual control. A conceptual design was also presented for a three-degree of freedom force reflecting manual controller with four alternative configurations. Such a system presents an augmented virtual reality methodology to enhance the sense of presence of the operator at the remote environment when such environments are dangerous and not amenable for direct human involvement.

DTIC

Robotics; Man Machine Systems; Controllers; Teleoperators; Operator Performance; Control

20030005763 Westat Research, Inc., Rockville, MD USA

2000 Military Recruiter Survey: Administration, Datasets and Codebook

Zucker, Andrea B.; Aug. 2002; 429p; In English; Original contains color images
Contract(s)/Grant(s): DASW01-98-M-2108

Report No.(s): AD-A408152; No Copyright; Avail: Defense Technical Information Center (DTIC)

In 1989, the first Recruiter Survey was administered to obtain baseline information regarding field recruiters' perceptions of issues related to recruiter quality of life. Since then, the Recruiter Survey has been administered in 1991, 1994, 1996, 1998 and 2000. The survey results provided are based on returns from active-duty Service production recruiters- those with at least one year of recruiting experience and assigned a goal/mission. The 2000 Military Recruiter Survey: Administration, Datasets and Codebook contains information describing the datasets and instructions to analysts for using the datasets.

DTIC

Data Bases; Surveys; Personnel Development

20030006100 Boeing Phantom Works, Open Systems Architecture, Seattle, WA USA

Multi-Community Cyber Defense (MCCD) *Final Report, Oct. 1999-Dec. 2001*

Smith, Randall; Nov. 2002; 41p; In English
Contract(s)/Grant(s): F30602-99-C-0181; AF Proj. H561

Report No.(s): AD-A408408; AFRL-IF-RS-TR-2002-293; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This program developed and demonstrated automated technologies enabling security devices to cooperatively respond to network intrusions across small-to-very-large-scale networks while spanning administrative domains. Theatre-wide network defense is achieved by enabling cooperative intrusion tracking and by sharing attack-related information and response recommendations between neighboring domains. This effort extended the Intruder Detection and Isolation Protocol (IDIP), which uses intrusion detection systems and cooperating boundary controllers within a single administrative domain to track network intruders to their origin and dynamically change network-level access control policies to stop the attacks in real-time. The focus of this effort was to develop, implement, and demonstrate enhancements to IDIP extending the intrusion tracing, response, and reporting mechanisms over organizational boundaries, enabling organizations to control the intrusion-related information they share and the degree of cooperation they provide, and to provide a policy-driven service that recommendations changes to local cooperation policies based on the threat status of neighboring communities. A real-time, strategic-level intrusion correlation engine was developed and demonstrated using the inter-community information sharing services to receive anomaly reports from neighboring communities, enabling early detection of widespread, stealthy scanning activities that would otherwise go undetected.

DTIC

Cybernetics; Detection; Automatic Control; Electronic Warfare; Computer Systems Programs

20030006274 Kestrel Inst., Palo Alto, CA USA

Agentware: Automated Synthesis of Software Agents Final Report, Jun. 1998-Sep. 2001

Smith, Douglas R.; Westfold, Stephen J.; Oct. 2002; 16p; In English

Contract(s)/Grant(s): F30602-98-C-0169; AF Proj. AGEN

Report No.(s): AD-A408501; AFRL-IF-RS-TR-2002-278; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report describes our research on developing and applying synthesis technology to agent-based systems in the DARPA/AFRL COABS program. We summarize our results in the following areas: generic synthesis frameworks, synthesis of scheduling agents, synthesis of authentication protocols, formal metalevel specifications, and synthesis of authentication protocols, formal metalevel specifications, and synthesis of glue code.

DTIC

Computer Programs; Software Development Tools

20030006276 Pittsburgh Univ., Pittsburgh, PA USA

Plan Management Capabilities for Autonomous Agents: Extending the Basic Mechanisms Final Report, May 2000-May 2002

Pollack, Martha E.; Oct. 2002; 87p; In English

Contract(s)/Grant(s): F30602-00-2-0547; AF Proj. AGEN

Report No.(s): AD-A408497; AFRL-IF-RS-TR-2002-268; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Software agents can assist a human user in overseeing, managing and coordinating large and potentially complex sets of plans. Such agents are potentially of great value in both military and civilian applications. This report addresses plan management software agent technology. There were three main goals in the research: 1. Design, implementation, and experimental analysis of algorithms for supporting plan management capabilities in agent software systems. 2. Adaptation of the plan management agents into a system that can interact with the agent sandbox, or 'grid', developed in the DARPA CoABS program for agent registry, search, and interaction. 3. Development of initial techniques for using the plan management agent algorithms to support outsourcing of tasks in agent communities,

DTIC

Software Engineering; Management Planning

20030006473 Naval Research Lab., Washington, DC USA

Voice Biometrics for Information Assurance Applications

Kang, George S.; Lee, Yvette; Dec. 05, 2002; 43p; In English; Original contains color images

Report No.(s): AD-A408449; NRL/FR/5550-02-10; Rept-044; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In 2002, the President of the USA established an organization within the DOD to develop and promulgate biometrics technologies to achieve security in information, information systems, weapons, and facilities. NRL has been tasked to study voice biometrics for applications in which other biometrics techniques are difficult to apply. The ultimate goal of voice biometrics is to enable the use of voice as a password. Voice biometrics are "man-in-the-loop" systems in which system performance is significantly dependent on human performance. This aspect has not been properly emphasized by previous researchers in this field. Accordingly, we let each speaker choose his (or her) own test phrase that can be uttered consistently. The speech waveform

is then pre-processed (i.e, equalized and normalized) to reduce the effect of inconsistent speaking. Subsequently, we extract five different voice features from the speech waveform. Some of them have never been used for voice biometrics. Finally, individual feature errors are combined to indicate a confidence level of speaker verification. Initial laboratory testing under various conditions shows encouraging results. We will be prepared to fleet-test our voice biometrics system in FY03.

DTIC

Biometrics; Computer Information Security; Voice Communication; Defense Program

64

NUMERICAL ANALYSIS

Includes iteration, differential and difference equations, and numerical approximation.

20030005450 NASA Glenn Research Center, Cleveland, OH USA

A New Domain Decomposition Approach for the Gust Response Problem

Scott, James R., NASA Glenn Research Center, USA; Atassi, Hafiz M., Notre Dame Univ., USA; SUSAn-Resiga, Romeo F., Notre Dame Univ., USA; December 2002; 16p; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 722-96-00

Report No.(s): NASA/TM-2002-212010; NAS 1.15:212010; E-13699; AIAA Paper 2003-0883; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A domain decomposition method is developed for solving the aerodynamic/aeroacoustic problem of an airfoil in a vortical gust. The computational domain is divided into inner and outer regions wherein the governing equations are cast in different forms suitable for accurate computations in each region. Boundary conditions which ensure continuity of pressure and velocity are imposed along the interface separating the two regions. A numerical study is presented for reduced frequencies ranging from 0.1 to 3.0. It is seen that the domain decomposition approach in providing robust and grid independent solutions.

Author

Airfoils; Gusts; Aeroacoustics; Boundary Conditions; Dynamic Response

20030005686 Scripps Institution of Oceanography, Marine Physical Lab., La Jolla, CA USA

Optical and Ancillary Measurements at High Latitudes in Support of the MODIS Ocean Validation Program Final Report

Stramski, Dariusz, Scripps Institution of Oceanography, USA; Stramska, Malgorzata, University of Southern California, USA; Dec. 15, 2002; 8p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG5-6466; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The overall goal of this project was to validate and refine ocean color algorithms at high latitudes in the north polar region of the Atlantic. The specific objectives were defined as follows: (1) to identify and quantify errors in the satellite-derived water-leaving radiances and chlorophyll concentration; (2) to develop understanding of these errors; and (3) to improve in-water ocean color algorithms for retrieving chlorophyll concentration in the investigated region.

Author

Numerical Analysis; Optical Measurement; Algorithms; Errors; Chlorophylls; Radiance; Water Color

20030005921 NASA Marshall Space Flight Center, Huntsville, AL USA

Profile-following Entry Guidance Using Linear Quadratic Regulator Theory

Dukeman, Greg A., NASA Marshall Space Flight Center, USA; Jun. 01, 2002; 7p; In English; AIAA Guidance, Navigation and Control Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

This paper describes one of the entry guidance concepts that is currently being tested as part of Marshall Space Flight Center's Advance Guidance and Control Project. The algorithm is of the reference profile tracking type. The reference profile consists of the reference states, range-to-go, altitude, and flight path angle, and reference controls, bank angle and angle of attack, versus energy. A linear control law using state feedback is used with energy-scheduled gains. The gains are obtained offline using Matlab's steady state linear quadratic regulator function. Lateral trajectory control is effected by performing periodic bank sign reversals based on a heading error corridor. A description and results of the AG&C test cases on which it has been tested are given. Although it is not anticipated that the algorithm will be quite as robust as algorithms with onboard trajectory re-generation capability, the results nevertheless show it to be very robust with respect to varying initial conditions and works satisfactorily even

for entries from widely different orbits than that of the reference profile. Moreover, the commanded bank and angle of attack histories are very smooth, making it easier for the attitude control system to implement the guidance commands. Finally, results indicate that the guidance gains are more or less trajectory-independent which is a potentially useful property.

Author

Algorithms; Attitude Control; Angle of Attack; Flight Control; Trajectory Control

20030005934 Woods Hole Oceanographic Inst., Dept. of Physical Oceanography, MA USA

Generalized-alpha Time Integration Solutions for Hanging Chain Dynamics

Gobat, Jason I.; Grosenbaugh, Mark A.; Triantofyllou, Michael S.; Journal of Engineering Mechanics; Jun. 2002; Volume 128, No. 6, pp. 677-687; In English

Contract(s)/Grant(s): N00014-92-J-1269

Report No.(s): AD-A408357; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper, we study numerically the two and three-dimensional nonlinear dynamic response of a chain hanging under its own weight. Previous authors have employed the box method, a finite-difference scheme popular in cable dynamics problem, for this purpose. The box method has significant stability problems, however, and thus is not well suited to that highly nonlinear problem. We illustrate these stability problems and propose a new time integration procedure based on the generalized-alpha method. The new method exhibits superior stability properties compared to the box method and other algorithms such as backward differences and trapezoidal rule. Of four time integration methods tested, the generalized-alpha algorithm was the only method that produced a stable solution for the three-dimensional whirling motions of a hanging chain driven by harmonic linear horizontal motion at the top.

DTIC

Dynamics; Chains; Numerical Analysis

20030006727 NASA Langley Research Center, Hampton, VA USA

Scaling Laws Applied to a Modal Formulation of the Aeroservoelastic Equations

Pototzky, Anthony S., NASA Langley Research Center, USA; [2002]; 16p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-26 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1598; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

A method of scaling is described that easily converts the aeroelastic equations of motion of a full-sized aircraft into ones of a wind-tunnel model. To implement the method, a set of rules is provided for the conversion process involving matrix operations with scale factors. In addition, a technique for analytically incorporating a spring mounting system into the aeroelastic equations is also presented. As an example problem, a finite element model of a full-sized aircraft is introduced from the High Speed Research (HSR) program to exercise the scaling method. With a set of scale factor values, a brief outline is given of a procedure to generate the first-order aeroservoelastic analytical model representing the wind-tunnel model. To verify the scaling process as applied to the example problem, the root-locus patterns from the full-sized vehicle and the wind-tunnel model are compared to see if the root magnitudes scale with the frequency scale factor value. Selected time-history results are given from a numerical simulation of an active-controlled wind-tunnel model to demonstrate the utility of the scaling process.

Author

Aeroservoelasticity; Equations of Motion; Finite Element Method; Mathematical Models; Wind Tunnel Models

66

SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.

20030006318 Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA

Congruent Weak Conformance

Brower, Ronald W.; Sep. 2002; 201p; In English

Report No.(s): AD-A408519; AFIT/DS/ENG/02-04; No Copyright; Avail: CASI; A10, Hardcopy; A03, Microfiche

This research addresses the problem of verifying implementations against specifications through an innovative logic approach. Congruent weak conformance, a formal relationship between agents and specifications, has been developed and proven to be a congruent partial order. This property arises from a set of relations called weak conformations. The largest, called weak

conformance, is analogous to Milner's observational equivalence. Weak conformance is not an equivalence, however, but rather an ordering relation among processes. Weak conformance allows behaviors in the implementation that are unreachable in the specification. Furthermore, it exploits output concurrencies and allows interleaving of extraneous output actions in the implementation. Finally, reasonable restrictions in CCS syntax strengthen weak conformance to a congruence, called congruent weak conformance. At present, congruent weak conformance is the best known formal relation for verifying implementations against specifications. This precongruence derives maximal flexibility and embodies all weaknesses in input, output, and no-connect signals while retaining a fully replaceable conformance to the specification. Congruent weak conformance has additional utility in verifying transformations between systems of incompatible semantics. This dissertation describes a hypothetical translator from the informal simulation semantics of VHDL to the bisimulation semantics of CCS. A second translator is described from VHDL to a broadcast-communication version of CCS. by showing that they preserve congruent weak conformance, both translators are verified.

DTIC

Algebra; Telecommunication

20030006331 North Carolina State Univ., Raleigh, NC USA

North Carolina State University Team (NCSU): Joint Forces Air Component Command (JFACC) Experiment *Final Report*, Aug. 1999-Jun. 2001

McEneaney, William M.; Ito, Kazufumi; Zhang, Quing; Fitzpatrick, Ben; Lauko, Istvan; Oct. 2002; 94p; In English; Original contains color images

Contract(s)/Grant(s): F30602-99-2-0548; AF Proj. J108

Report No.(s): AD-A408264; AFRL-IF-RS-TR-2002-244; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Command and Control (C2) problem for Military Air Operations is addressed. The problem is viewed as a stochastic game. Due to the large size of the problem, several techniques are used to decompose the problem into manageable pieces. At the outermost level, hierarchical techniques are used to solve progressively larger problems where the distributions of outcomes at one level become the dynamics of the problem at the next higher level. At the lowest level, the problem may consist of a few aircraft (or possibly packages), less than say a half-dozen, enemy SAMs, a few enemy assets (viewed as targets from our standpoint), and some enemy decoys (assumed to mimic SAM radar signatures). At this low level, some minimal cost (to our aircraft) routes to the eventual targets are mapped out, and these are used to determine SAM sites (possibly decoys) that are unavoidable. One then employs a discrete stochastic game problem formulation to determine which of these SAMs should optimally be engaged, and by what series of aircraft operations. Since this is a game model, the optimal opponent strategy is also determined. The problem of imperfect information is addressed. The technique also allows the evaluation of various approaches in terms of expected cost and the variance of cost. One may plot these as functions of various parameters to determine when the situation is at a point where the optimal strategies may jump out suddenly.

DTIC

Mathematical Models; Command and Control; Radar Signatures

67

THEORETICAL MATHEMATICS

Includes algebra, functional analysis, geometry, topology set theory, group theory and and number theory.

20030005500 Air Force Research Lab., Air Vehicles Directorate, Wright-Patterson AFB, OH USA

Optimal Control Problems on Riemannian Manifolds: Theory and Applications

Venkataraman, Ram; Holsapple, Raymond; Doman, DAvid; Aug. 2002; 28p; In English; Prepared in collaboration with the Dept. of Mathematics and Statistics, Texas Tech Univ. Lubbock, TX. Journal article submitted Sept. 26, 2002 for publication in SIAM Journal of Control

Report No.(s): AD-A408334; AFRL-VA-WP-TP-2002-321; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Any air vehicle can be thought of as evolving on Riemannian manifold with the total kinetic energy as the metric. In this paper, we first derive first-order necessary conditions for a Boiza-type optimal control problem on a Riemannian manifold. Then we apply this theory to a rotating rigid body, by obtaining expressions for the Riemannian connection and curvature tensor via Cartan's formalism.

DTIC

Applications of Mathematics; Cauchy Problem; Riemann Manifold; Rigid Structures

20030005521 Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

Efficient Solution of the Long-Rod Penetration Equations of Alekseevskii-Tate

Segletes, Steven B.; Waters, William P.; Sep. 2002; 24p; In English

Report No.(s): AD-A408548; ARL-TR-2855; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The exact solution to the long-rod penetration equations is revisited, in search of improvements to the solution efficiency, while simultaneously enhancing the understanding of the physical parameters that drive the solution. Substantial improvements are offered in these areas. The presentation of the solution is simplified in a way that more tightly unifies the special and general-case solutions to the problem. Added computational efficiencies are obtained by expressing the general-case solution for penetration and implicit time in terms of a series of Bessel functions. Other extensions and efficiencies are addressed, as well.

DTIC

Physical Properties; Bessel Functions

20030006261 Geophysical Observatory, Helsinki, Finland

Inequalities for Conformal Capacity, Modulus, and Conformal Invariants

Heikkala, Ville, Geophysical Observatory, Finland; Martio, Olli, Editor, Helsinki Univ., Finland; 2002; ISSN 1239-6303; 68p; In English

Report No.(s): Rept-132; ISBN 951-41-0927-9; Copyright; Avail: Issuing Activity

In 1950, the extremal length of a curve family was introduced by L. V. Ahlfors and A. Beurling. Its roots lie in the length-area method, which has been widely applied in geometric function theory. In this context one usually rather considers the modulus. There is also a variation of the modulus method, due to M. Vuorinen and his collaborators, in which the modulus is replaced by two conformal invariants $\lambda(\text{sub } G)$ and $\mu(\text{sub } G)$, defined as extremal moduli of certain special curve families in a domain G in $\mathbb{R}(\text{sup } n)$. This theory has two main parts, namely the study and estimation of the above conformal invariants and their transformation rules under quasiregular mappings. We are mainly involved with the first part of this theory, providing estimates for the modulus as well as $\lambda(\text{sub } G)$ and $\mu(\text{sub } G)$. We also study conformal capacity, a concept closely related to the modulus of a curve family. We provide new upper and lower bounds for the capacity of a condenser consisting of a compact set and its t -neighborhood for t greater than 0. Most of our results are based on thickness assumptions posed either on the set whose capacity is studied or on the boundary of G in the study of $\mu(\text{sub } G)$. Such assumptions are Ahlfors regularity, uniform perfectness, and a continuum criterion of O. Martio. We also investigate the interdependence of these criteria. Section 2 begins with a review of the preliminaries and then proceeds to the investigation of the behaviour of the modulus. There are also some growth estimates for the modulus in Section 5. In Section 3 we restrict our attention to the plane, where many of the quantities introduced in Section 2 have explicit representations or at least better estimates than in higher dimensions. We study the two dimensional Teichmüller capacity, the function p which provides an answer to Teichmüller's extremal problem, and the modulus. The topic of Section 4 is the relationship between the conformal capacity and the thickness of a compact set in $\mathbb{R}(\text{sup } N)$. In Section 5 we discuss the continuum criterion of Martio. In both Sections 4 and 5 we compare the thickness criteria, proving that Ahlfors regularity implies uniform perfectness, which furthermore guarantees that the continuum criterion holds. We also provide counterexamples to show that converse implications fail to hold. We begin Section 6 by recalling the definitions and some basic properties of the conformal invariants $\lambda(\text{sub } G)$ and $\mu(\text{sub } G)$. Then we proceed to compare the topologies defined by these quantities to the Euclidean topology. We prove new estimates for $\lambda(\text{sub } B(\text{sup } n)) \setminus \{0\}$ and comparison results between $\lambda(\text{sub } B(\text{sub } n)) \setminus \{0\}$ and $\lambda(\text{sub } B(\text{sup } n))$. This is the content of Section 7.

Author

Inequalities; Invariance; Curves; Conformal Mapping

20030006440 Geophysical Observatory, Helsinki, Finland

Meromorphic Solutions of Differential and Difference Equations with Deficiencies

Korhonen, Risto, Geophysical Observatory, Finland; Martio, Olli, Editor, Helsinki Univ., Finland; 2002; ISSN 1239-6303; 96p; In English

Report No.(s): Rept-129; ISBN 951-41-0918-X; Copyright; Avail: Issuing Activity

In this thesis, we consider differential equations and difference-differential equations from the point of view of Nevanlinna theory. We start by recalling the basic notations of Nevanlinna theory, as well as some elementary results from real analysis and from complex differential equations in Section 1. The rest of the paper can be divided into three parts as follows: Firstly, we study algebraic differential equations in Section 2. We obtain information about the deficient slowly moving targets of solutions of differential equations in the general case, and more specific results in some special cases, such as the homogeneous and the nonhomogeneous cases. Moreover, we find an interesting connection between deficient slowly moving targets of a meromorphic function and hypertranscendence of the function. Secondly, we consider algebraic differential equations of the first and the second

order in Sections 3 and 4, respectively. In the first order case, we focus on the behavior of the generalized Malmquist differential equations. In particular, we study the value distribution of solutions of Riccati differential equations with rational coefficients. In Section 4, we concentrate mainly on the value distribution of the Painleve transcendents, but also second order linear homogeneous differential equations are briefly examined. Finally, in Section 5, we apply Nevanlinna theory to obtain some information about solutions of algebraic difference-differential equations. Among other things, we obtain a theorem which can be described as an analogue of the lemma of the logarithmic derivative for difference-differential equations. This theorem is further applied to prove a lemma of Clunie type for these equations.

Derived from text

Meromorphic Functions; Differential Equations; Difference Equations

20030006441 Geophysical Observatory, Helsinki, Finland

Mappings of Finite Distortion: The Metric Definition

Kallunki, Sari, Geophysical Observatory, Finland; 2002; 38p; In English

Report No.(s): Rept-131; ISBN 951-41-0926-0; Copyright; Avail: Issuing Activity

This thesis is organized as follows. In section 2, we give basic definitions and prove useful geometric lemmas. In section 3, we give integrability conditions for $H(\text{sub } f)$ to guarantee that a mapping f is absolutely continuous on almost all lines parallel to the coordinate axes, shortly ACL, or that it belongs to a Sobolev class, and as the last result of the section we prove a local quasimetric condition. In the last section, we tackle the more difficult problem of showing analogous results for open, continuous, discrete mappings with $h(\text{sub } f)$ satisfying various integrability conditions. We also give a sufficient integrability condition for $h(\text{sub } f)$ to guarantee that f has an exponentially integrable K -distortion. The last section is mainly motivated by the paper of Cristea.

Author

Distortion; Theorems

70

PHYSICS (GENERAL)

Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see categories 71 through 77. For related instrumentation see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.

20030005515 Advanced Materials Corp., Pittsburgh, PA USA

Study of Prospective Candidates for High Performance Magnets Final Report, Jun. 1998-Oct. 2002

Sankar, S. G.; Oct. 31, 2002; 61p; In English

Contract(s)/Grant(s): N00014-98-C-0268

Report No.(s): AD-A408469; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The objective of this work is to examine the structural and magnetic properties of materials that are of interest in high performance magnets. During the program, a number of alloys have been investigated.

DTIC

Magnetic Properties; Structural Analysis

20030005590 Worcester Polytechnic Inst., Dept. of Mechanical Engineering, MA USA

Electrostatic Effects on Droplet Suspensions

Tryggvason, Gretar, Worcester Polytechnic Inst., USA; Fernandez, Arturo, Worcester Polytechnic Inst., USA; Esmaeeli, Asghar, Worcester Polytechnic Inst., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 432-443; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Direct numerical simulations are used to examine the effect of electric fields on the behavior of a suspensions of drops in channels. The effect of the electric field is modeled using the "leaky dielectric" model, coupled with the full Navier-Stokes equations. The governing equations are solved using a front-tracking/finite volume technique. The method has been validated by detailed comparison with previous results for the axisymmetric interactions of two drops in Stokes flow. An extensive set of two-dimensional simulations has allowed us to explore the effect of the conductivity and permittivity ratios in some detail. The interaction of two drops is controlled by two effects. The drops are driven together due to the charge distribution on the surface. Since the net charge of the drops is zero, the drops see each other as dipoles. This dielectrophoretic motion always leads to drops

attraction. The second effect is fluid motion driven by tangential stresses at the fluid interface. The fluid motion depends on the relative magnitude of the permittivity and conductivity ratios. When the permittivity ratio is higher than the conductivity ratio, the tangential forces induce flow from the poles of the drops to the equator. If the center of two such drops lies on a line parallel to the electric field, the flow drains from the region between the drops and they attract each other. When the ratios are equal, no tangential motion is induced and the drops attract each other by dielectrophoretic motion. When an electric field is applied to many drops suspended in a channel flow, drops first attract each other pair-wise and some drops move to the wall. If the forces are strong (compared to the fluid shear) the drops can form columns or fibers, spanning the channel and blocking the two-dimensional flow. Electronic "fibration" of suspensions has been observed in a number of systems, including dispersion of milk droplets and red blood cells. If the attractive forces are weak compared to the shear, the columns are immediately broken up. For drops with the permittivity ratio lower than the conductivity ratio, the tangential forces induce flow in the opposite direction (from the equator to the poles of the drops) and if the induced fluid motion is sufficiently strong, the drops repel each other. In two-dimensions, this results in interactions between the drops that are similar to the previous case, except that the attractions take place perpendicular to the electric field. The drops therefore tend to form rows aligned with the flow, or "slugs" where many drops clump together. When the conductivity ratio is much higher than the permittivity ratio, the drops become prolate, expel each other and are spread more uniformly across the channel. Figure 1 shows two frames from one simulation of 36 drops in a channel. The parameters used result in oblate drops and two drops whose centers are on a line parallel to the electric field attract each other. After the electric field is turned on, the pairwise interactions of drops initially leads to the formation of drop pairs and columns of drops parallel to the field. The drops are also attracted to the walls by the same mechanism that drops are attracted to each other and eventually all the drops migrate to the walls. In this case the drops are not allowed to coalesce, but in reality we would expect the drops to form fluid layers next to the walls.

Author

Electrostatics; Electric Fields; Drops (Liquids); Navier-Stokes Equation; Finite Volume Method

20030005721 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

PPT Research at AFRL: Material Probes to Measure the Magnetic Field Distribution in a Pulsed Plasma Thruster

Spanjers, Greg; Spores, R. A.; Jul. 1998; 17p; In English; Presented at the AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit (34th) Held in Cleveland, OH on July 12-15, 1998

Report No.(s): AD-A408109; AIAA Paper 98-3659; AFRL-PR-ED-TP-1998-159; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The focus of the PPT basic research program at AFRL has now shifted to understanding the sources of the low energy efficiency. Based on previous research modifications such as changing the electrode geometry, discharge frequency, and discharge energy may all result in moderate increases to the energy efficiency. What is required from a basic research standpoint is a diagnostic capability that can acquire information with sufficient accuracy to enable PPT designers to understand why certain influences increase performance -and then design PPTs which maximize these effects. to model a fluid description of the PPT plasma, the critical measurements are magnetic field and density. Temperature, composition and charge state also become critical as the models become more detailed. This paper describes a magnetic field probe array used at AFRL to map the magnetic fields in a laboratory model PPT. The paper focuses on determining to what extent the probe perturbs the plasma, the measurement limitations. Also discussed are options towards making this critical measurement with increased accuracy.

DTIC

Magnetic Fields; Pulsed Plasma Thrusters; Energy Conservation; Charged Particles

20030006317 Lawrence Livermore National Lab., Livermore, CA USA

Thermal Shock Structural Analyses of a Positron Target

Stein, W.; Bharadwaj, V. K.; Schultz, D. C.; Sheppard, J. C.; Aug. 2002; 8p; In English

Report No.(s): DE2002-800056; SLAC-PUB-9437; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In the positron source of the Stanford Linear Collider (SLC), the electron beam collides with a tungsten-rhenium target. As the beam passes into the material, thermal energy is created that heats the material to several hundred degrees centigrade on a time scale of nanoseconds. The heating of the material results in thermal stresses that may be large enough to cause material failure. The analyses calculate the thermal shock pressure and stress pulses as they move throughout the material due to the rapid energy deposition. Failure of the target occurred after three years of operation with an elevated power deposition toward the end of the three years. The calculations were made with the LLNL coupled heat transfer and dynamic solid mechanics analysis codes, TOPAZ3D and DYNA3D, and the thermal energy deposition was calculated with the SLAC Electron Gamma Shower (EGS) code

simulating the electron-induced cascade. Material fatigue strength, experimentally measured properties for the non-irradiated and irradiated material, as well as the calculated stress state are evaluated in assessing the cause for the target failure.

NTIS

Positrons; Targets; Thermal Shock; Structural Analysis

20030006699 Sandia National Labs., Albuquerque, NM USA

Discrete Ordinates Approximations to the First- and Second-Order Radiation Transport Equations

Fan, W. C.; Drumm, C. R.; Powell, J. L.; Jun. 2002; 58p; In English

Report No.(s): DE2002-800996; SAND2002-1880; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The conventional discrete ordinates approximation to the Boltzmann transport equation can be described in a matrix form. Specifically, the within-group scattering integral can be represented by three components: a moment-to-discrete matrix, a scattering cross-section matrix and a discrete-to-moment matrix. Using and extending these entities, we derive and summarize the matrix representations of the second-order transport equations.

NTIS

Radiation Transport; Approximation; Boltzmann Transport Equation

20030006705 Stanford Linear Accelerator Center, Stanford, CA USA

Higher Luminosity B-Factories

Seeman, J. T.; Aug. 2002; 8p; In English

Report No.(s): DE2002-800050; SLAC-PUB-9431; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The present B-factories PEP-II and KEK-B have reached luminosities of $3\text{--}4 \times 10^{33}/\text{sq cm/s}$ and delivered integrated luminosity at rates in excess of $4\text{fb}(\text{sup } -1)$ per month. The recent turn on of these two B-Factories has shown that modern accelerator physics, design, and engineering can produce colliders that rapidly reach their design luminosities and deliver integrated luminosities capable of frontier particle physics discoveries. PEP-II and KEK-B with ongoing upgrade programs should reach luminosities of over $10^{34}/\text{sq cm/s}$ in a few years and with more aggressive improvements may reach luminosities of order $10^{35}/\text{sq cm/s}$ by the end of the decade.

NTIS

Luminosity; Research Facilities; Beams (Radiation); Storage Rings (Particle Accelerators)

20030006706 Stanford Linear Accelerator Center, Stanford, CA USA

Start-to-End Jitter Simulations of the Linac Coherent Light Source

Borland, M.; Chae, Y. C.; Milton, S.; Soliday, R.; Bharadwaj, V.; Aug. 2002; 8p; In English

Report No.(s): DE2002-800046; SLAC-PUB-9427; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Linac Coherent Light Source (LCLS) is a fourth generation light source demonstration project based on the self-amplified spontaneous emission (SASE) free-electron laser (FEL) concept. It will combine a new photo-injector, the Stanford Linear Accelerator Center (SLAC) linac, with two stages of bunch compression and a long undulator to create intense radiation pulses at 1.5 A. Successful operation of the LCLS will require consistent delivery of a high brightness electron beam to the undulator, in the face of effects such as wakefields and coherent synchrotron radiation (CSR). Because of the sensitivity to beam quality and subtle effects, it is necessary to perform integrated tracking from the cathode through the undulator. We report on the combined use of PARMELA, elegant, and GENESIS to perform these simulations, and in particular the simulation of pulse-to-pulse variation in FEL performance due to rf and laser-related variation in the electron beam.

NTIS

Linear Accelerators; Light Sources; Beams (Radiation); Vibration; Synchrotron Radiation; Coherent Light

20030006713 Stanford Linear Accelerator Center, Stanford, CA USA

Beam Instability and Microbunching due to Coherent Synchrotron Radiation

Heifets, S.; Stupakov, G.; Aug. 2002; 8p; In English

Report No.(s): DE2002-800043; SLAC-PUB-9425; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A beam microwave instability induced by the coherent radiation of the density fluctuations is studied theoretically in this paper. We consider the case when CSR of a bunch as a whole is suppressed by screening and is caused by microstructures with longitudinal dimensions small compared to the bunch length. In this case, we can simplify consideration studying stability of a coasting beam with the line density equal to the local line density of the bunch.

NTIS

Coherent Radiation; Synchrotron Radiation; Beam Steering

20030006714 Stanford Linear Accelerator Center, Stanford, CA USA

Spear 3 Injection Kicker

Sebek, J.; Arnett, D.; Langton, J.; Pappas, C.; Aug. 2002; 8p; In English

Report No.(s): DE2002-800040; SLAC-PUB-9422; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The design of the SPEAR 3 injection kicker system is presented. This system will include three kicker magnets and their associated pulsed. The magnet design is based on the DELTA kicker magnets, which present a low RF impedance to the beam, and are relatively straightforward to construct. The pulsed use cascaded IGBT stages that are based on the modulator pulsed developed by a SLAC/LLNL collaboration for the NLC. Design considerations and the results of prototype tests will be discussed.

NTIS

Beam Injection; Design Analysis; Magnets; Prototypes; Injection

20030006715 Tennessee Univ., Knoxville, TN USA

Resonant Cavity for Single-Shot Emittance Measurement

Kim, J. S.; Nantista, C. D.; Whittum, D. H.; Miller, R. H.; Tantawi, S. G.; Aug. 2002; 8p; In English

Report No.(s): DE2002-800038; SLAC-PUB-9420; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present a non-invasive, resonant cavity based approach to beam emittance measurement of a shot-to-shot non-circular beam pulse of multi-bunches. One measurement alone provides the rms-beam size if the beam position is given, for instance, by nearby beam-position-monitors. This paper describes the basic design and analysis of a Quad-cavity beam monitoring system.

NTIS

Cavity Resonators; Emittance; Linear Accelerators

20030006716 Stanford Linear Accelerator Center, Stanford, CA USA

Run Scenarios for the Linear Collider

Battaglia, M.; Wells, J.; Butler, J.; Montgomery, H. E.; Cahn, R. N.; Aug. 2002; 12p; In English

Report No.(s): DE2002-799979; SLAC-PUB-9334; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

In the report, scenarios are developed for runs at a Linear Collider, in the case that there is a rich program of new physics. For this study, the authors examine a scenario with a light SM-like Higgs boson of mass 120 GeV and two minimal supergravity (mSUGRA) models with many low mass particles.

NTIS

Linear Accelerators; Higgs Bosons; Particle Mass

20030006717 Stanford Linear Accelerator Center, Stanford, CA USA

Measurement of $\sin(2\beta)$ in $B(\text{sup } 0)$ Yields $\Phi K(\text{sup } 0)(\text{sub } s)$: The BABAR Collaboration

Jul. 24, 2002; 20p; In English

Report No.(s): DE2002-799949; SLAC-PUB-9297; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present a preliminary measurement of the time-dependent CP-violating asymmetry in the neutral B decay $B(\text{sup } 0) \rightarrow (\phi)K(\text{sup } 0)(\text{sub } s)$ with $(\phi) \rightarrow K+K^-$ and $K(\text{sup } 0)(\text{sub } s) \rightarrow \phi + \phi$. The measurement uses a data sample of about 87 million $(\gamma\gamma)(4S) \rightarrow BB$ decays collected between 1999 and 2002 with the BABAR detector at the PEP-II asymmetric-energy B Factory at SLAC. In this sample we study events in which the CP final state is fully reconstructed and the flavor of the other neutral B meson is determined from its decay products.

NTIS

Invariance; Particle Decay; Time Dependence; Nuclides

20030006720 Department of Energy, Washington, DC USA

Development of the Relaxation Method of Specific Heat for Measurements at MilliKelvin Temperatures and High Magnetic Fields

2002; 10p; In English

Report No.(s): DE2002-797610; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

During this period of time we have made a strong strife to further develop the specific heat method for very low temperatures and the highest accessible fields. The specific heat is the most important probe that provides the most basic information on low temperature states of solids. It is of particular importance to strongly correlated electron systems and heavy fermions, whose main hallmark is strongly enhanced low temperature specific heat. The discovery of non-Fermi liquid behavior in f-electron systems, manifesting itself as divergent C/T (specific heat divided by temperature) at $T=0$, necessitated accurate measurement of the

specific heat to the lowest accessible temperatures. Finally, it has been shown that external magnetic field is the most appropriate and readily available parameter that can tune a physical system to a quantum critical point.

NTIS

Magnetic Fields; Specific Heat; Heat Measurement; Fermi Liquids

20030006728 Stanford Linear Accelerator Center, Stanford, CA USA

First Hint of Non-Standard CP Violation from B Yields $\Phi K(\text{sub } s)$ Decay

Hiller, G.; Oct. 2002; 10p; In English

Report No.(s): DE2002-799973; SLAC-PUB-9326; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The author comments on the implications of the recently measured CP asymmetry in Beta $\rightarrow \Phi K(\text{sub } s)$ decay. the data disfavor the Standard model at 2.7 (sigma) and - if the trend persists in the future with higher statistics - require the existence of CP violation beyond that in the CKM Matrix.

NTIS

Invariance; Cp Violation; Decay

20030006732 Fermi National Accelerator Lab., Batavia, IL USA

Conceptual Design Study of Nb(3)Sn Low-beta Quadrupoles for 2nd Generation LHC IRs

Zlobin, A. V.; Ambrosio, G.; Andreev, N.; Barzi, E.; Bauer, P.; Oct. 2002; 8p; In English

Report No.(s): DE2002-803320; FERMILAB-CONF-02/170; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Conceptual designs of 90-mm aperture high gradient quadrupoles based on the Nb3Sn superconductor, are being developed at Fermilab for possible 2nd generation IRs with the similar optics as in the current low-beta insertions. Magnet designs and results of magnetic, mechanical, thermal and quench protection analysis for these magnets are presented and discussed.

NTIS

Quadrupoles; Superconductors (Materials); Accelerators; Niobium; Tin; Magnets

20030006744 Army Research Lab., Weapons and Materials Research Directorate, Aberdeen Proving Ground, MD USA

Evaluation of the IMPAC66 Shock Test Machine, Serial Number 118 Final Report

Childers, Marshal A.; Oct. 2002; 27p; In English

Contract(s)/Grant(s): Proj-IL162618H80

Report No.(s): AD-A408194; ARL-TR-2840; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this evaluation is to calibrate and identify the performance capabilities of the MTS IMPAC66 high velocity acceleration (HVA) shock test machine, Serial Number 118. This unit is currently situated at the U. S. Army Research Laboratory (ARL) in Building 4600 (Lab 1252) at Aberdeen Proving Ground, Maryland, and is used by ARL's Weapons and Materials Research Directorate. The IMPAC66 shock test machine was designed to simulate high acceleration and/or high velocity scenarios. Shock tests performed at ARL are used to determine the survivability of electronic sensing packages when these are exposed to various launching environments. Typical accelerations associated with gun-launched munitions can range from 1500 g's to 30,000 g's². The results provided in this report will be used as a reference for the shock test applications performed within ARL. This work will also be used as a benchmark for post-refurbishment and post-maintenance performance verification. The IMPAC66 shock test machine, Serial Number 118, was evaluated for calibration and performance with respect to current USAge at ARL and for future reference in testing and maintenance functions. Several series of experiments were conducted to determine the effects of felt programmer thickness, accelerometer performance, and signal conditioning on measured shock pulses. Specifically, experiments were performed to determine the effects of three programmer thicknesses, four cut-off frequencies, and two accelerometer measurement ranges.

DTIC

Shock Tests; High Acceleration

71
ACOUSTICS

Includes sound generation, transmission, and attenuation. For noise pollution see 45 Environment Pollution. For aircraft noise see also 02 Aerodynamics and 07 Aircraft Propulsion Propulsion and Power.

20030005503 Washington Univ., Applied Physics Lab., Seattle, WA USA

Remote Sensing of Sand Ripples Using High-Frequency Backscatter

Tang, Dajun; Williams, Kevin L.; Thorsos, Eric I.; Briggs, Kevin B.; Oct. 31, 2002; 7p; In English; Original contains color images
Contract(s)/Grant(s): N00014-02-WX-3017

Report No.(s): AD-A408366; NRL/PP/7430--02-0006; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

It is critical for buried target detection via ripple scattering to know the ripple structure, e.g., the ripple height and spatial wavelength. In the present paper, backscattering data from a 300-kHz system show that ripple wavelength and height can potentially be estimated from backscattering images. Motivated by the backscatter data, we have developed a time-domain numerical model to simulate scattering of high-frequency sound by a ripple field. This model treats small-scale scatterers as Lambertian scatterers distributed randomly on the large-scale ripple field. We have found that this approach characterizes the field data well. Numerical simulations are conducted to investigate the possibility of remotely sensing bottom ripple heights and wavelength.

DTIC

Backscattering; Ripples; Remote Sensing; Sands

20030005607 National Inst. of Standards and Technology, Gaithersburg, MD USA

Acoustic Experiment to Measure the Bulk Viscosity of Near-Critical Xenon in Microgravity

Gillis, K. A., National Inst. of Standards and Technology, USA; Shinder, I., National Inst. of Standards and Technology, USA; Moldover, M. R., National Inst. of Standards and Technology, USA; Zimmerli, G. A., National Center for Microgravity Research on Fluids and Combustion, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 556-570; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

We plan a rigorous test of the theory of dynamic scaling by accurately measuring the bulk viscosity of xenon in microgravity 50 times closer to the critical temperature T_c than previous experiments. The bulk viscosity ζ (or "second viscosity" or "dilatational viscosity") will be determined by measuring the attenuation length of sound $\alpha\lambda$ and also measuring the frequency-dependence of the speed of sound. For these measurements, we developed a unique Helmholtz resonator and specialized electro-acoustic transducers. We describe the resonator, the transducers, their performance on Earth, and their expected performance in microgravity.

Author

Microgravity; Viscosity; Xenon; Attenuation Coefficients

20030005812 Naval Submarine Medical Research Lab., Groton, CT USA

Sensor-Operated Headset Selection for Virginia Class Submarine Consoles (3CI)

Russotti, Joseph S.; Schwaller, Derek W.; Oct. 23, 2001; 24p; In English; Original contains color images

Report No.(s): AD-A408227; NSMRL-1221; No Copyright; Avail: Defense Technical Information Center (DTIC)

The current research evaluated various headsets for use on C3I (Command, Control, Communication and Intelligence workstation) consoles installed in Virginia Class submarine. of particular importance is their intended application in accurately presenting not only communications but also passive acoustic sonar data and other future advanced auditory displays that may use spatial coding. Of these applications accurate representation of broadband sonar data becomes the most challenging immediate task. Headset evaluation of commercial off-the-shelf products confirmed our decision to press for development of high fidelity ANC sensor operator headsets. This study reports evaluation of a prototype ANC high fidelity headset developed to our specification for use in critical listening in a moderately noisy environment.

DTIC

Earphones; Display Devices; Telecommunication

ATOMIC AND MOLECULAR PHYSICS

Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see 73 Nuclear Physics.

20030004847 Ohio State Univ., Research Foundation, Columbus, OH USA

Submillimeter Laboratory Investigations: Spectroscopy and Collisions *Final Report, 1 May 1998 - 30 Apr. 2002*

Herbst, Eric, Ohio State Univ., USA; DeLucia, Frank C., Ohio State Univ., USA; Oct. 23, 2002; 8p; In English

Contract(s)/Grant(s): NAG5-7252; RF Proj. 735768; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Currently, millimeter-wave and submillimeter-wave spectroscopy is conducted in our laboratory on several different types of spectrometers. Our standard spectrometer utilizes the output of a phase-locked klystron operating in the 40-60 GHz region, which is sent into a crossed-waveguide harmonic generator, or "multiplier". The high frequency millimeter- and submillimeter-wave radiation is transmitted via quasi-optical techniques through an absorption cell and then onto a detector, which is either an InSb hot electron bolometer cooled to 1.4 K or a Si bolometer cooled to 0.3 K. The detector response is sent to a computer for measurement and analysis. The frequency range produced and detected in this manner goes from 80 GHz to upwards of 1 THz. Spectra are normally taken with source modulation, with line frequencies typically measured to an accuracy of 50-100 kHz. Higher accuracy is available when needed. Recently, we developed a new, broad-band spectrometer in our laboratory based on a free-running backward wave oscillator (BWO) of Russian manufacture as the primary source of radiation. The so-called FASSST (fast-scan submillimeter spectroscopic technique) system uses fast-scan and optical calibration methods rather than the traditional locking techniques. The output power from the BWO is split such that 90% goes into the absorption cell while 10% is coupled to a 40-meter Fabry-Perot cavity, which yields fringe? for frequency measurement. Results from this spectrometer on the spectrum of nitric acid (HNO₃) show that 100 GHz of spectral data can be obtained in 5 seconds with a measurement accuracy of 50 kHz. Currently, the frequency range of the FASSST system in our laboratory is roughly 100-700 GHz.

Derived from text

Spectroscopic Analysis; Submillimeter Waves; Spectrometers; Ionic Collisions; Molecular Ions

20030005734 Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

Theoretical Investigations of HEDM

Sheehy, Jeffrey A.; Apr. 30, 1998; 24p; In English

Report No.(s): AD-A408539; AFRL-PR-ED-TP-1998-094; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

These viewgraphs discuss topics such as: HEDM theory and computations, potential-energy surfaces, diatomic-molecule calculations, vibrational frequencies and intensities of cyclic C(6), identification of cyclic C(8) in argon matrix, approach to propellant ingredient modeling, payoffs from propellant ingredient modeling, and application to aluminum-argon clusters.

DTIC

Diatomic Molecules; High Energy Propellants; Matrices (Mathematics); Argon

NUCLEAR PHYSICS

Includes nuclear particles; and reactor theory. For space radiation see 93 Space Radiation. For atomic and molecular physics see 72 Atomic and Molecular Physics. For elementary particle physics see 77 Physics of Elementary Particles and Fields. For nuclear astrophysics see 90 Astrophysics.

20030006711 Stanford Linear Accelerator Center, Stanford, CA USA

SLAC's Polarized Electron Source Laser System and Minimization of Electron Beam Helicity Correlations for the E-158 Parity Violation Experiment

Humensky, T. B.; Alley, R.; Brachmann, A.; Browne, M. J.; Clendenin, J.; Sep. 2002; 70p; In English

Report No.(s): DE2002-801993; SLAC-PUB-9381; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

SLAC E-158 is an experiment designed to make the first measurement of parity violation in Moller scattering. E-158 will measure the right-left cross-section asymmetry, $A(\text{sup Moller})(\text{sub LR})$, in the elastic scattering of a 45-GeV polarized electron beam off unpolarized electrons in a liquid hydrogen target. E-158 plans to measure the expected Standard Model asymmetry of approximately 10 to the minus 7th power to an accuracy of better than 10 to the minus 8th power. to make this measurement, the polarized electron source requires for operation an intense circularly polarized laser beam and the ability to quickly switch

between right- and left-helicity polarization states with minimal right-left helicity-correlated asymmetries in the resulting beam parameters (intensity, position, angle, spot size, and energy), beam ALR's.

NTIS

Electron Beams; Electron Sources; Optimization; Parity; Elastic Scattering; Standard Model (Particle Physics)

74 OPTICS

Includes light phenomena and the theory of optical devices. For lasers see 36 Lasers and Masers.

20030005511 Naval Undersea Warfare Center, Newport, RI USA

Phase Sensitivity of Conventional Single-Mode, PANDA, and Holey Optical Fibers: A Comparison Study

Chiu, Wilson K.; Maguire, Jason M.; Berliner, Marilyn J.; Sep. 16, 2002; 18p; In English; Original contains color images
Report No.(s): AD-A408460; NUWC-NPT-TR-11391; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A comparison of phase sensitivity was conducted for three different types of optical-fiber designs having the same outer diameter. The optical fibers were subjected to a 1-micronPa harmonic pressure load at excitation frequencies ranging from 1 Hz to 5 kHz. The polarization-maintaining and absorption-reducing optical fiber exhibited a marginal 6.3% gain in phase sensitivity over a conventional single-mode optical fiber. The holey fiber selected for this study showed a significant 130% phase sensitivity gain over conventional single-mode optical fiber, enabling the external harmonic load to strain the core beyond that observed in solid optical fibers.

DTIC

Fiber Optics; Fibers; Optical Materials

20030005551 California Univ., Dept. of Physics and Astronomy, Los Angeles, CA USA

Multiple Light Scattering using 3rd Order Correlations Functions

Gittings, A. S., California Univ., USA; Lemieux, P. A., California Univ., USA; Durian, D. J., California Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 158-159; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Multiple light scattering provides a non-invasive method for probing the structure of optically opaque materials such as aqueous foam, colloids and sand. Diffusion-wave spectroscopy (DWS) examines the intensity fluctuations of the speckle pattern to extract dynamical information about the scattering sites. When many, uncorrelated scattering sites are present, the electric field is a random Gaussian variable, and the dynamics are easily determined from the second order intensity correlation function $g^{(2)}(\tau)$. $g^{(2)}(\tau) = 1 + \beta(|\langle E(t)E^*(t+\tau) \rangle|^2 / |\langle E \rangle|^2)$ $g^{(2)}(\tau) = 1 + \beta(|\langle \gamma(\tau) \rangle|^2)$ This crucial relation relates the measured $g^{(2)}(\tau)$ with the electric field auto-correlation function $\gamma(\tau)$, which can then be expressed in terms of the scattering site dynamics. It is not possible, however, to tell whether the Gaussian approximation is valid by inspection of $g^{(2)}(\tau)$ alone. Recently, a method has been developed to test whether the scattering is Gaussian by measuring higher order intensity correlation functions. In this experiment we measured the third order intensity correlation function $g^{(3)}(\tau_1, \tau_2)$ for aqueous foam (Gillette Foamy Regular) and compared it with the Gaussian prediction for $g^{(3)}(\tau_1, \tau_2)$. $g^{(3)}(\tau_1, \tau_2) = 1 + \beta_1(|\langle \gamma_1 \rangle|^2) + \beta_2(|\langle \gamma_2 \rangle|^2) + 2\beta_1\text{Re}(\langle \gamma_1 \rangle \langle \gamma_2 \rangle)$. Preliminary data indicate that the scattering is Gaussian to sixth order in the electric field.

Author

Light Scattering; Correlation; Diffusion Waves; Spectroscopy; Speckle Patterns

20030005552 California Univ., Dept. of Physics and Astronomy, Los Angeles, CA USA

Absorption Optics of Aqueous Foams

Bandyopadhyay, Ranjini, California Univ., USA; Gittings, Alex, California Univ., USA; Durian, D. J., California Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2160-161; 2p; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Aqueous foams are composed of gas bubbles packed together in a small volume of soapy water. The large number of gas-liquid interfaces in foams results in very strong scattering of light, which explains the opaque nature of conventional aqueous

foams such as shaving foams and mousse. For dry foams, the interfaces can take the following three forms: the soap films where two bubbles meet, the triangular plateau borders where three soap films meet and the vertices where four plateau borders meet. Previous experiments have shown that most of the scattering occurs from the plateau borders [2,3] and the transport mean free path of light (l^*), the bubble radius (R) and the liquid fraction of foam (ϵ) is related through the relation $l^* = R/(\epsilon \exp(0.5))$. To understand the reflection and scattering of light at the gas-bubble interfaces, we study the absorption of photons in the liquid network as a function of the foam absorptivity. We do this to confirm if the time spent by the photons in the liquid phase is proportional to the liquid fraction of the foam. Our results indicate that for a specific range of liquid fractions ($0.05 < \epsilon < 0.1$), the photons seem to get trapped in the liquid network. This result is independent of the absorptivity of the foam and leads us to conclude that under appropriate conditions, an aqueous foam behaves very much like an optical fiber network. Aqueous foam is generated in the lab by the method of turbulent mixing of N_2 gas with a jet of alpha-olefin-sulfonate (AOS) solution. The foam has been made absorbing by dissolving small quantities of rhodamine dye ($[R] = 0.005$ g/l, $[R] = 0.01$ g/l and $[R] = 0.0124$ g/l) in the AOS solution. The transmission of photons through the foams of liquid fractions $0.0297 < \epsilon < 0.35$ has been studied using Diffuse Transmission Spectroscopy (DTS). For each liquid fraction, the transport mean free path l^* (the length over which the photon travels before it gets completely randomized) has been estimated from DTS experiments on foams with $[R] = 0.0$ g/l. In the liquid fraction range $0.05 < \epsilon < 0.1$, the ratio is found to be lower than the theoretical prediction. The deviation of the experimental estimates of $(l_{\text{sub a}}^{\text{sup foam}})/(l_{\text{sub a}}^{\text{sup soln}})$ from the solid line leads us to conclude that at $0.05 < \epsilon < 0.1$, the foam behaves like an optical fiber network with the photons getting trapped in and then channeled through the plateau borders. We believe that our results may be explained quantitatively by relating the reflectance of light at liquid-gas and gas-liquid interfaces to the average angles of incidence at these interfaces. Additional information is included in the original extended abstract.

Author

Absorptivity; Foams; Photoabsorption; Photons; Reflectance

20030005712 Air Force Research Lab., Propulsion Directorate, Wright-Patterson AFB, OH USA

Demonstration of Temperature Measurement on a Curved Surface Using Thermographic Phosphors *Final Report, 28 May 1991-30 Sep. 1992*

Ervin, Jamie; Murawski, Christopher; MacArthur, Charles; Chyu, Minking; Bizzak, David; May 2002; 26p; In English; Prepared in collaboration with Mechanical and Aerospace Engineering Dept. Univ. of Dayton, OH; Mechanical Engineering Dept. Carnegie-Mellon Univ. Pittsburgh, PA

Contract(s)/Grant(s): Proj-ILIR

Report No.(s): AD-A408122; AFRL-PR-WP-TR-2002-2083; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An optical technique for surface temperature measurement based on the fluorescent emission of rare-earth ion-doped phosphors was demonstrated in an experiment with a heated cylinder in cross flow. In this experiment, a uniform heat flux is imposed by applying a constant voltage across the thin stainless-steel cylinder surface to produce surface temperatures between 24 deg. C and 55 deg. C. The fluorescent emission of a thermographic phosphor, lanthanum oxysulfide doped with europium ($La_2O_2S:Eu^{+3}$) deposited on the surface, was recorded to determine the temperature distribution at the curved surface. When excited by ultraviolet radiation, the phosphor emits a spectrum containing certain emission lines, and the intensities of these vary with temperature.

DTIC

Thermography; Phosphors; Temperature Measurement; Temperature Distribution

75

PLASMA PHYSICS

Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see 90 Astrophysics.

20030005444 NASA Marshall Space Flight Center, Huntsville, AL USA

An Experimental Study of a Pulsed Electromagnetic Plasma Accelerator

Thio, Y. C. Francis, NASA Marshall Space Flight Center, USA; Eskridge, Richard, NASA Marshall Space Flight Center, USA; Lee, Mike, NASA Marshall Space Flight Center, USA; Smith, James, NASA Marshall Space Flight Center, USA; Martin, Adam, NASA Marshall Space Flight Center, USA; Markusic, Tom E., NASA Marshall Space Flight Center, USA; Cassibry, Jason T., Alabama Univ., USA; [2002]; 13p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4269; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Experiments are being performed on the NASA Marshall Space Flight Center (MSFC) pulsed electromagnetic plasma accelerator (PEPA-0). Data produced from the experiments provide an opportunity to further understand the plasma dynamics in these thrusters via detailed computational modeling. The detailed and accurate understanding of the plasma dynamics in these devices holds the key towards extending their capabilities in a number of applications, including their applications as high power (greater than 1 MW) thrusters, and their use for producing high-velocity, uniform plasma jets for experimental purposes. For this study, the 2-D MHD modeling code, MACH2, is used to provide detailed interpretation of the experimental data. At the same time, a 0-D physics model of the plasma initial phase is developed to guide our 2-D modeling studies.

Author

Magnetohydrodynamics; Plasma Accelerators; Plasma Jets

20030005527 Iowa Univ., Iowa City, IA USA

Nonlinear Theory of Void Formation in Colloidal Plasmas

Bhattacharjee, A., Iowa Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 2; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

A colloidal (or dusty) plasma is an electron-ion plasma containing a dispersed phase of micron-size solid particles. In typical plasma conditions, these particles usually acquire a large negative charge. As a result of the strong Coulomb coupling between the dust particles, a colloidal plasma may undergo phase transitions and exist in a liquid or a crystalline state. Recently, a number of colloidal plasma experiments, in laboratory as well as under microgravity conditions, have shown the spontaneous development of voids. A void is typically a small and stable centimeter-size region (within the plasma) that is completely free of dust particles and characterized by sharp boundaries. In the laboratory, the void is seen to develop from a uniform dust cloud as a consequence of an instability when the dust particle has grown to a sufficient size. The instability is first seen as a so-called filamentary mode, which exhibits a sudden onset. The filaments take the form of beam-like striations in the dust density and glow. The spectrum of the filamentary mode is observed to be broadband, with a peak at about 100 Hz. After onset, the filaments are seen to evolve rapidly (in about 10 ms) to a nonlinear saturated state containing a single void. Theoretical analyses have confirmed that the ion drag force plays a crucial role in causing the initial instability. These analyses fall into two types: linear stability analyses that include the effect of ion drag, and nonlinear but steady-state analyses that yield void solutions. As yet, there appears to be no nonlinear time-dependent model that describes the spontaneous development of the linear instability and its subsequent saturation to produce a void. In this paper we propose a basic, time-dependent, self-consistent nonlinear model for void formation in a dusty plasma.

Author

Colloids; Dusty Plasmas; Microparticles; Nonlinearity; Plasmas (Physics); Stability; Mathematical Models

20030005556 Naval Research Lab., Div. of Plasma Physics, Washington, DC USA

Phase Transition in Dusty Plasmas: A Microphysical Description

Joyce, Glenn, Naval Research Lab., USA; Ganguli, Gurudas, Naval Research Lab., USA; Lampe, Martin, Naval Research Lab., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 178-181; In English; Also announced as 20030005526; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

Dust grains immersed in plasma discharges acquire a large negative charge and settle into a dust cloud at the edge of the sheath. In this region, the plasma ions stream toward the electrode at a velocity $u \approx c_s = (T_e/m_i)^{1/2}$. Experimentally at sufficiently high gas pressure P , the random kinetic energy of the grains is damped by gas friction, and the grains are strongly coupled and self-organize into a crystalline configuration. For lower pressures despite the dissipation of grain kinetic energy to gas friction, the dust grains reach a steady-state kinetic temperature T_d which is much larger than the temperature of any other component in the plasma. T_d is so large that the dust acts like a fluid. We have used the dynamically shielded dust (DSD) model to simulate these physical processes. We find that the known experimental features are nicely reproduced in the simulations, and that additional features are revealed. In the figure we plot the variation of T_d as P is continuously varied in a DSD code run. A marked difference is evident between the critical pressure P_m for the melting transition as P is decreased, and the critical pressure P_c for the condensation transition as P is increased. For $P_m < P < P_c$, mixed phase states are seen. This hysteresis occurs because the instability which triggers melting is different from the instability that heats the dust in the fluid phase and inhibits freezing. At low pressure, the dust is subject to a two-stream instability with the ions. This instability is responsible for the high temperature of the dust at low pressure. The basic physics underlying the melting transition

has been elucidated in a series of papers. We are developing a first-principles analytic approach to the melting transition, which embodies the same physics that is present in the DSD code.

Author

Phase Transformations; Dust; Plasma Jets; Models; Hysteresis

20030006260 Air Force Flight Dynamics Lab., Structural Vibration Branch, Wright-Patterson AFB, OH USA

Test Report on Vibration Measurements on a Lightweight MHD Generator Channel *Final Report, Apr.-Sep. 1977*

Pearson, Jerome; Thaller, Roger E.; Banazak, David L.; Mar. 1978; 102p; In English

Report No.(s): AD-A408242; AFFDL-TM-77-4; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This test report presents data which define the vibration environment of a lightweight magnetohydrodynamic (MHD) generator channel. These data were needed to determine the vibration responses of the MHD channel during rocket engine operation. Descriptions of the MHD test channel, instrumentation, test procedure, data analysis, and a discussion of the test results are presented in Appendix A. Figures, tables, and photographs are presented in Appendix B.

DTIC

Vibration; Magnetohydrodynamic Generators; Vibration Measurement

20030006712 Argonne National Lab., IL USA

Flow of a Two-Dimensional Liquid Metal Jet in a Strong Magnetic Field

Molokov, S.; Reed, C. B.; 2002; 10p; In English

Report No.(s): DE2002-801628; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A combined effect of surface tension, gravity, inertia and a transverse nonuniform magnetic field on the steady, two-dimensional jet (or curtain) flow is studied with reference to liquid metal divertors of tokamaks and coating flows. Here main fundamental aspects of the flow are presented. More details on the assumptions, analysis and results are given in. Consider a steady flow of a viscous, electrically conducting, incompressible fluid in a jet pouring downward in the x-asterisk-direction (the direction of gravity) from a nozzle.

NTIS

Magnetic Fields; Two Dimensional Flow; Liquid Metals; Jet Flow

20030006734 Lawrence Livermore National Lab., Livermore, CA USA

Indirect-Drive Non-Cryogenic Double-Shell Ignition Targets for the National Ignition Facility: Design and Analysis

Amendt, P.; Colvin, J.; Tipton, R. E.; Hinkel, D.; Edwards, M. J.; Oct. 15, 2001; 52p; In English

Report No.(s): DE2002-802925; UCRL-JC-145878; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The central goal of the National Ignition Facility (NIF) is demonstration of controlled thermonuclear ignition. The mainline ignition target is a low-Z, single-shell cryogenic capsule designed to have weakly nonlinear Rayleigh-Taylor growth of surface perturbations. Double-shell targets are an alternative design concept that avoids the complexity of cryogenic preparation but has greater physics uncertainties associated with performance-degrading mix. A typical double-shell design involves a high-Z inner capsule filled with DT gas and supported within a low-Z ablator shell. The largest source of uncertainty for this target is the degree of highly evolved nonlinear mix on the inner surface of the high-Z shell. High Atwood numbers and feed-through of strong outer surface perturbation growth to the inner surface promote high levels of instability. The main challenge of the double-shell target designs is controlling the resulting nonlinear mix to levels that allow ignition to occur.

NTIS

Design Analysis; Ignition; Thermonuclear Reactions; Targets; Plasma Physics

76

SOLID-STATE PHYSICS

Includes condensed matter physics, crystallography, and superconductivity. For related information see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.

20030005506 Iowa Univ., Dept. of Chemistry, Iowa City, IA USA

Solvothermal Molecular Precursor Routes to Semiconductor Film and Crystal Growth *Final Report, Aug. 1999-Aug 2002*

Gillan, Edward G.; Aug. 2002; 7p; In English

Contract(s)/Grant(s): N00014-99-1-0953

Report No.(s): AD-A408376; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This research project explored the utility of molecular precursor decomposition in superheated non-aqueous solvents directed towards semiconductor crystal growth. Reactions were run in toluene, THF, and under solvent free conditions. An in situ precursor synthesis and decomposition resulted in GaN nanoparticles from simple starting materials (GaCl₃ and NaN₃). Particle sizes range from about 10 to hundreds of nanometers. Upon annealing to 1000 degrees C, the poorly crystalline products ordered into crystalline hexagonal GaN and luminescence. The conversion of synthesized organometallic dimeric gallium amino precursors to GaN was less successful; however they showed some utility in vapor phase film growth. Silver and silver sulfide nanoparticles were also produced in a solvothermal system via silver azide decomposition producing particles in the 100 nm to micron size regime.

DTIC

Molecules; Semiconductors (Materials); Crystal Growth; Nanoparticles

20030005529 Colorado Univ., Dept. of Physics, Boulder, CO USA

Studies of Islands on Freely Suspended Bubbles of Smectic Liquid Crystal

Pattanaporkratana, A., Colorado Univ., USA; Mavel, B., Colorado Univ., USA; Park, C. S., Colorado Univ., USA; MacLennan, J. E., Colorado Univ., USA; Clark, N. A., Colorado Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 4; In English; Also announced as 20030005526; Original contains color illustrations

Contract(s)/Grant(s): NAG3-1846; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We have constructed an optical system for observing the internal structure of freely suspended smectic liquid crystal bubbles using a reflected light microscope. Liquid crystal bubbles can have thicker circular regions (islands) which can easily be generated by shrinking the bubble diameter. The diameter of these islands is approximately 10 microns and they are typically up to five times thicker than the surrounding liquid crystal film (500 angstroms). In the Laboratory, the location of the islands is strongly influenced by gravity, which causes the majority of islands to migrate to the bottom half of the bubble. We will describe the size and thickness distributions of islands and their time evolution, and also discuss two-dimensional hydrodynamics and turbulence of smectic bubbles, the shapes of islands and holes affected by bubble vibrations, and the interactions between islands, which we have probed using optical tweezers.

Author

Bubbles; Liquid Crystals; Hydrodynamics; Suspensions

20030005595 NASA Marshall Space Flight Center, Huntsville, AL USA

Tetragonal Lysozyme Nucleation and Crystal Growth: The Role of the Solution Phase

Pusey, Marc L., NASA Marshall Space Flight Center, USA; Forsythe, Elizabeth, NASA Marshall Space Flight Center, USA; Sumida, John, NASA Marshall Space Flight Center, USA; Maxwell, Daniel, NASA Marshall Space Flight Center, USA; Gorti, Sridhar, NASA Marshall Space Flight Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 462; In English; Also announced as 20030005526; No Copyright; Abstract Only; Available from CASI only as part of the entire parent document

Lysozyme, and most particularly the tetragonal form of the protein, has become the default standard protein for use in macromolecule crystal nucleation and growth studies. There is a substantial body of experimental evidence, from this and other laboratories, that strongly suggests this proteins crystal nucleation and growth is by addition of associated species that are preformed by standard reversible concentration-driven self association processes in the bulk solution. The evidence includes high resolution AFM studies of the surface packing and of growth unit size at incorporation, fluorescence resonance energy transfer measurements of intermolecular distances in dilute solution, dialysis kinetics, and modeling of the growth rate data. We have developed a selfassociation model for the proteins crystal nucleation and growth. The model accounts for the obtained crystal symmetry, explains the observed surface structures, and shows the importance of the symmetry obtained by self-association in solution to the process as a whole. Further, it indicates that nucleation and crystal growth are not distinct mechanistically, but identical, with the primary difference being the probability that the particle will continue to grow or dissolve. This model also offers a possible mechanism for fluid flow effects on the growth process and how microgravity may affect it. While a single lysozyme molecule is relatively small (M.W. = 14,400), a structured octamer in the 4(sub 3) helix configuration (the proposed average sized growth unit) would have a M.W. = 115,000 and dimensions of 5.6 x 5.6 x 7.6 nm. Direct AFM measurements of growth unit incorporation indicate that units as wide as 11.2 nm and as long as 11.4 nm commonly attach to the crystal. These measurements were made at approximately saturation conditions, and they reflect the sizes of species that both added or desorbed from the crystal surface. The larger and less isotropic the associated species the more likely that it will be oriented to some degree in a flowing boundary layer, even at the low flow velocities measured about macromolecule crystals. Flow-driven effects resulting in misorientation upon addition to and incorporation into the crystal need only be a small fraction of a percentage to significantly

affect the resulting crystal. One Earth, concentration gradient driven flow will maintain a high interfacial concentration, i.e., a high level (essentially that of the bulk solution) of solute association at the interface and higher growth rate. Higher growth rates mean an increased probability that misaligned growth units are trapped by subsequent growth layers before they can be desorbed and try again, or that the desorbing species will be smaller than the adsorbing species. In microgravity the extended diffusive boundary layer will lower the interfacial concentration. This results in a net dissociation of aggregated species that diffuse in from the bulk solution, i.e., smaller associated species, which are more likely able to make multiple attempts to correctly bind, yielding higher quality crystals.

Author

Crystal Growth; Crystal Surfaces; Tetragons; Lysozyme; Nucleation; Solutes; Proteins

20030005610 Ohio State Univ., Columbus, OH USA

Progress in Modeling Nonlinear Dendritic Evolution in Two and Three Dimensions, and Its Mathematical Justification

Tanveer, S., Ohio State Univ., USA; Foster, M. R., Ohio State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 583-584; In English; Also announced as 20030005526

Contract(s)/Grant(s): NAG3-2700; No Copyright; Avail: CASI; A01, Hardcopy; A06, Microfiche

We report progress in three areas of investigation related to dendritic crystal growth. Those items include: 1. Selection of tip features dendritic crystal growth; 2) Investigation of nonlinear evolution for two-sided model; and 3) Rigorous mathematical justification.

Author

Dendritic Crystals; Nonlinearity; Crystal Growth; Two Dimensional Models; Three Dimensional Models

20030005950 Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

Vibrational Spectra of Linear BC₃ and Linear B₂C₂ in Argon at 10K(a)

Presilla-Marquez, Jose D.; Carrick, Patrick G.; Larson, C. W.; Nov. 16, 1998; 25p; In English; Presented in part at the Ohio State University International Symposium on Molecular Spectroscopy (52nd) held in Columbus, OH on 16-20 Jun. 1997

Contract(s)/Grant(s): AF Proj. 2303

Report No.(s): AD-A408396; AFRL-PR-ED-TP-FY99-0028; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The vibrational spectra of linear BC₃ and linear B₂C₂ in an argon matrix at 10 K have been observed for the first time by Fourier transform infrared spectroscopy. Mixtures of boron and carbon powders were vaporized in a resistively heated (~3000 K) oven. BC₃ was produced during co-deposition of the vapors with argon onto a CsI substrate maintained at 10 K; B₂C₂ was observed only after annealing the matrices. Frequencies measured at 2002.1 and 1512.5/cm have been assigned to the $\nu_1(\sigma)$ and $\nu_2(\sigma)$ B-C stretching fundamentals of linear BC₃ and a frequency measured at 955.0/cm has been assigned to the $\nu_3(\sigma_{\text{sub } u})$ stretching fundamental of linear symmetric BC₂B. These assignments are based on FTIR measurements of the majority of the BC₃ and B₂C₂ isotopomer frequencies and are consistent with the results from Rittby's collaborative ab-initio study.

DTIC

Argon; Vibrational Spectra; Linearity; Powder (Particles); Boron Carbides

20030006718 Argonne National Lab., IL USA

Transient Response of Single-Domain Y-Ba-Cu-O Rings to Pulsed Magnetic Fields

Askew, T. R.; Weber, J. M.; Cha, Y. S.; Claus, H.; Veal, B. W.; Aug. 2002; 10p; In English

Report No.(s): DE2002-799826; SLAC-PUB-9420; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Shielding current limits and magnetic diffusion characteristics have been measured at 77 K for a set of YBCO single-domain rings. These were fabricated from melt-textured cylindrical YBCO monoliths that were densified to nearly 100%, and then oriented from a single seed. The rings were surrounded by a drive coil that can, under pulse conditions, achieve applied magnetic fields in excess of 1 T and induce currents in excess of 50 kA. Simultaneous magnetic characterization with a Rogowski coil and Hall probe was used to determine the induced current in the sample and the magnetic field in the center of the sample. Magnetic fields trapped in the samples were mapped with a scanning Hall probe. When compared with similar measurements on multidomain c-axis-oriented YBCO rings, the flux penetration is faster and more uniform around the circumference of the ring. The observed critical current density, 15,000 A/cm² at 77 K, is suitable for application in penetration-type fault current limiters.

Separate measurements of the trapped magnetic field and critical current density in the rings are compared with results obtained by analysis of magnetic diffusion characteristics.

NTIS

Electromagnetic Shielding; Storage Rings (Particle Accelerators); Magnetic Fields; YBCO Superconductors; Cylindrical Bodies; Critical Current

20030006719 Westinghouse Savannah River Co., Aiken, SC USA

High Purity Germanium Gamma-PHA Assay of Uranium Scrap Cans Used in 321-M Facility

Salaymeh, S. R.; Dewberry, R. A.; Casella, V.; Dec. 18, 2001; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799690; WSRC-TR-2001-00084; No Copyright; Avail: National Technical Information Service (NTIS)

The Analytical Development Section of SRTC was requested by the Facilities Disposition Division (FDD) to determine the holdup of enriched uranium in the 321-M facility as part of an overall deactivation project of the facility. The 321-M facility was used to fabricate enriched uranium fuel assemblies, lithium-aluminum target tubes, neptunium assemblies, and miscellaneous components for the production reactors. The facility also includes the 324-M storage building and the passageway connecting it to 321-M. The results of the holdup assays are essential for determining compliance with the Solid Waste's Waste Acceptance Criteria, Material Control & Accountability, and to meet criticality safety controls. This report describes and documents the use of a portable HPGe detector and EG&G DART system that contains a high voltage power supply, signal processing electronics, a personal computer with Gamma-Vision software, and space to store and manipulate multiple 4096-channel gamma-ray spectra to assay for ²³⁵U content. The system was used to assay a large number of scrap cans used to store highly enriched uranium (HEU) chips and filings. This report includes a description of two efficiency calibration configurations and also the results of the assay. A description of the quality control checks is included as well.

NTIS

Deactivation; Germanium; Purity; Uranium; Scrap; Cans

77

PHYSICS OF ELEMENTARY PARTICLES AND FIELDS

Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also 72 Atomic and Molecular Physics, 73 Nuclear Physics, and 25 Inorganic, Organic and Physical Chemistry.

20030005113 Michigan State Univ., Dept. of Mechanical Engineering, East Lansing, MI USA

Parametric Identification of Nonlinear Dynamical Systems Final Report, Apr. 2001 - Oct. 2002

Feeny, Brian, Michigan State Univ., USA; [2002]; 124p; In English

Contract(s)/Grant(s): NAG1-01048; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In this project, we looked at the application of harmonic balancing as a tool for identifying parameters (HBID) in a nonlinear dynamical systems with chaotic responses. The main idea is to balance the harmonics of periodic orbits extracted from measurements of each coordinate during a chaotic response. The periodic orbits are taken to be approximate solutions to the differential equations that model the system, the form of the differential equations being known, but with unknown parameters to be identified. Below we summarize the main points addressed in this work. The details of the work are attached as drafts of papers, and a thesis, in the appendix. Our study involved the following three parts: (1) Application of the harmonic balance to a simulation case in which the differential equation model has known form for its nonlinear terms, in contrast to a differential equation model which has either power series or interpolating functions to represent the nonlinear terms. We chose a pendulum, which has sinusoidal nonlinearities; (2) Application of the harmonic balance to an experimental system with known nonlinear forms. We chose a double pendulum, for which chaotic response were easily generated. Thus we confronted a two-degree-of-freedom system, which brought forth challenging issues; (3) A study of alternative reconstruction methods. The reconstruction of the phase space is necessary for the extraction of periodic orbits from the chaotic responses, which is needed in this work. Also, characterization of a nonlinear system is done in the reconstructed phase space. Such characterizations are needed to compare models with experiments. Finally, some nonlinear prediction methods can be applied in the reconstructed phase space. We developed two reconstruction methods that may be considered if the common method (method of delays) is not applicable.

Author

Differential Equations; Mathematical Models; Dynamical Systems; Nonlinear Systems; Parameter Identification; Balancing; Harmonic Analysis

20030005826 Brookhaven National Lab., Riken BNL Research Center, Upton, NY USA

Multi-Quark Hadrons: Production of $S = -2$ Systems

Kahana, D. E.; Kahana, S. H.; Aug. 26, 2002; 14p; In English

Report No.(s): DE2002-801701; BNL-69352; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The general character of 4-quark (mesonic) and strange 6-quark (baryonic) quark systems is very briefly reviewed a la JaEe, i. e. in the MIT bag, and so far still possibly viable candidates are indicated. The concentration is on the latter ($S = -2$) systems, with some attention given to more likely to be discoverable light, doubly-strange nuclei. The two modes for generating doubly strange, generally double- A nuclear systems, are considered and related to each other. Traditionally, one employs the (K^- , K^0) reaction on a relatively light target and hopes to retain two units of strangeness on a single final state fragment. Alternatively, heavy ion reactions can be used to produce A -hyperons copiously and one seeks to observe coalescence of two of these particles into the lightest $S = -2$ nucleus, the H-dibaryon. The complications arising from the presence of a repulsive core in the baryon-baryon interaction on the production of the H are discussed.

NTIS

Quarks; Hadrons; Particle Production; Elementary Particles; Nuclei (Nuclear Physics)

20030006733 Thomas Jefferson National Accelerator Facility, Newport News, VA USA

Interplay of Hard and Soft Processes at JLAB Energies

Afanasev, A.; Carlson, C. E.; Oct. 15, 2002; 12p; In English

Report No.(s): DE2002-803298; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Even at moderate energy machines, there is a regime where hard pion electroproduction proceeds by a perturbatively calculable process. The process, we claim, is not the leading twist fragmentation one but rather a higher twist process that produces kinematically isolated pions. Semiexclusive data may teach us more about parton distribution functions of the target and the pion distribution amplitude. In addition, there is a connection to generalized parton distribution calculations of exclusive processes in that the perturbative kernel is the same.

NTIS

Photoproduction; Pions; Perturbation Theory; Quantum Chromodynamics

80

SOCIAL AND INFORMATION SCIENCES (GENERAL)

Includes general research topics related to sociology; educational programs and curricula.

20030005104 Norfolk State Univ., Academic Affairs, VA USA

The CHROME Honors Program Final Report, 1 Oct. 2001 - 30 Sep. 2002

Wilson, Eleanor, Norfolk State Univ., USA; [2002]; 7p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG1-01127; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The CHROME Honors Program was designed as a two-week residential program for 9th and 10th grade students participating in CHROME clubs. The curriculum focused on the health sciences with instruction from: (1) the science and health curriculum of the Dozoretz National Program for Minorities in Applied Sciences (DNIMAS) Program of Norfolk State University (NSU); (2) the humanities curriculum of the NSU Honors Program; (3) NASA-related curriculum in human physiology. An Advisory Committee was formed to work with the Project Coordinator in the design of the summer program.

Author

Minorities; Education; Health; Students

81

ADMINISTRATION AND MANAGEMENT

Includes management planning and research.

20030005706 Johns Hopkins Univ., Bloomberg Center for Physics and Astronomy, Baltimore, MD USA

A Proposal to Investigate Outstanding Problems in Astronomy Final Report, 1 Dec. 2001 - 30 Nov. 2002

Ford, Holland, Johns Hopkins Univ., USA; Nov. 21, 2002; 24p; In English

Contract(s)/Grant(s): NAG5-7697; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During the period leading up to the spectacular launch of the Space Shuttle Columbia (STS-109) on 1 March 2002 6:22 am EST, the team worked hard on a myriad of tasks to be ready for launch. Our launch support included preparations and rehearsals for the support during the mission, preparation for the SMOV and ERO program, and work to have the science team's data pipeline (APSYS) and data archive (SDA) ready by launch. A core of the team that was at the GSFC during the EVA that installed ACS monitored the turn-on and aliveness tests of ACS. One hour after installation of ACS in the HST George Hartig was showing those of us at Goddard the telemetry which demonstrated that the HRC and WFC CCDs were cooling to their preset temperatures. The TECs had survived launch! After launch, the team had several immediate and demanding tasks. We had to process the ERO observations through our pipeline and understand the limitations of the ground based-based calibrations, and simultaneously prepare the EROs for public release. The ERO images and the SMOV calibrations demonstrated that ACS met or exceeded its specifications for image quality and sensitivity. It is the most sensitive instrument that Hubble has had. The ERO images themselves made the front page of all of the major newspapers in the US. During the months after launch we have worked on the SMOV observations, and are analyzing the data from our science program.

Derived from text

Space Transportation System; Extravehicular Activity; Calibrating; Telemetry

20030005821 NASA Langley Research Center, Hampton, VA USA

Recent Enhancements to the National Transonic Facility

Kilgore, W. A., NASA Langley Research Center, USA; Balakrishna, S., Vigyan Research Associates, Inc., USA; Bobbitt, C. W., NASA Langley Research Center, USA; Underwood, P., Vigyan Research Associates, Inc., USA; [2003]; 14p; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2003-0754; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The National Transonic Facility continues to make enhancements to provide quality data in a safe, efficient and cost effective method for aerodynamic ground testing. Recent enhancements discussed in this paper include the restoration of reliability and improved performance of the heat exchanger systems resulting in the expansion of the NTF air operations envelope. Additionally, results are presented from a continued effort to reduce model dynamics through the use of a new stiffer balance and sting

Author

Transonic Wind Tunnels; Wind Tunnel Tests; Aerodynamic Characteristics; Augmentation; Aerothermodynamics

82

DOCUMENTATION AND INFORMATION SCIENCE

Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.

20030005502 Air Force Flight Dynamics Lab., Structural Vibration Branch, Wright-Patterson AFB, OH USA

FIBG Report Writing Guide Final Report, Nov. 1983-Feb. 1987

Chinn, Janice; Bolds, Phyllis; Banaszak, David; Merkle, Robert; Dec. 1987; 177p; In English

Report No.(s): AD-A408352; AFWAL-TM-87-152-FIBG; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

One severe problem involved in publishing technical documents as been the uncertainty as to what should be reported. In some cases, project engineers are unaware of the procedures to follow. Consequently, technical efforts are not documented properly and cannot accurately be referenced or used for guidance in similar tasks. The lack of this information has resulted in redundancy, insufficient testing techniques and excessive costs for training individuals. To alleviate this deficiency, the Structural Dynamics Branch Quality Circle Group has implemented a comprehensive training and report writing guidebook aimed at obtaining quality technical documents in a timely manner. This report describes the six (6) stages of a technical effort. It defines the procedures of each stage and gives illustrations of processes, and sample completed forms for each. The purpose of this report is to assist people involved in test programs documenting technical efforts in a more accurate and timely manner.

DTIC

Manuals; Procedures; Quality Control; Technical Writing

20030005730 Oregon Univ., Eugene, OR USA

Understanding and Exploiting Hierarchy Final Report, Jun. 1997-Jun 2000

Etherington, David W.; Ginsberg, Matthew L.; Drabble, Brian; Jul. 2002; 47p; In English

Contract(s)/Grant(s): F30602-97-1-0294; AF Proj. COMP

Report No.(s): AD-A408557; AFRL-IF-RS-TR-2002-155; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The project made important progress in the three key areas it set out to address: information content, information flow and information processing, showing that explicit modeling of information, its content and the ways it changes, can provide a powerful means of handling large distributed problems. Among these, the use of generic task description templates greatly improves the agent-tasking process by making explicit the constraints and dependencies between tasks. Such task models allow algorithms to understand potential tradeoffs and identify ways tasks can be modified to suit the changing environment. The technologies and ideas developed during the project have been successfully applied to problems in mission planning and ISR management. In particular, the DEOS system developed under the project offers faster, more flexible solutions than those available using current technologies. Research on the information-processing aspects of process management highlighted several new approaches, particularly exploiting phase transitions. These are naturally occurring "computational cliffs" in problems that represent the point where problems transition from being manageable to being very difficult to solve. Many important problems fall in this transition region, making the potential payoff of this work very high.

DTIC

Computation; Resources Management; Hierarchies; Mission Planning; Data Processing; Information Flow

20030005818 Cornell Univ., Dept. of Computer Science, Ithaca, NY USA

AFRL/Cornell Information Assurance Institute Final Report, 15 Mar. 2000-31 Aug. 2002

Schneider, Fred B.; Nov. 13, 2002; 25p; In English

Contract(s)/Grant(s): F49620-00-1-209

Report No.(s): AD-A408240; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The AFRL/Cornell Information Assurance Institute supports a broad spectrum of research aimed at developing a science and technology base to enhance information assurance and networked information systems trustworthiness system and network security, reliability, and assurance. The institute also rosters closer collaborations between Cornell and AFRL researchers, as well as facilitating technology transfer and exposing Cornell researchers to problems facing the Air Force.

DTIC

Networks; Research and Development; Security; Research Facilities

20030006329 Department of Defense, Office of the Inspector General, Arlington, VA USA

Information System Security: Government Information Security Reform Act Implementation: Defense Advanced Research Projects Agency Management Support System

Nov. 25, 2002; 61p; In English

Report No.(s): AD-A408268; IG/DOD-D-2003-027; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

No abstract.

Author

Information Systems; Security; Support Systems

20030006667 Communications Research Lab., Japan

Imaging Riometer Database Developed in Cooperation with the University of Alaska

Mori, Hirotaka, Communications Research Lab., Japan; Murayama, Yasuhiro, Communications Research Lab., Japan; Ishii, Mamoru, Communications Research Lab., Japan; Yamamoto, Masa-Yuki, Communications Research Lab., Japan; Stenbaek-Nielsen, Hans C., Communications Research Lab., Japan; Review of the Communications Research Laboratory; June 2002; ISSN 0914-9279; Volume 48, No. 2, pp. 137-143; In Japanese; Original contains color illustrations; Copyright; Avail: Issuing Activity

To study the effects of the high-energy electron precipitations to the polar middle atmosphere, 'The CNA-auroral luminosity comparison database' is compiled in cooperation with the Geophysical Institute of the University of Alaska from the cosmic noise absorption (CNA) data obtained by the CRL's 256-element imaging riometer at Pokar Flat, Alaska and the auroral image data observed at the same place by the all-sky camera of the University of Alaska. The outside researchers can use this database with the convenient color contour plots by WWW through the Alaska data network system 'SALMON'.

Author

Middle Atmosphere; Riometers; Data Bases; Electron Precipitation; Polar Regions; Auroras

20030006689 Mississippi Univ., Office of Research, University, MS USA

The University of Mississippi Geoinformatics Center (UMGC) Final Report, 8 May 2000 - 30 Sep. 2002

Easson, Gregory L., Mississippi Univ., USA; [2003]; 16p; In English

Contract(s)/Grant(s): NAS13-00037; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The overarching goal of the University of Mississippi Geoinformatics Center (UMGC) is to promote application of geospatial information technologies through technology education, research support, and infrastructure development. During the initial two-year phase of operation the UMGC has successfully met those goals and is uniquely positioned to continue operation and further expand the UMGC into additional academic programs. At the end of the first funding cycle, the goals of the UMGC have been and are being met through research and educational activities in the original four participating programs; Biology, Computer and Information Science, Geology and Geological Engineering, and Sociology and Anthropology, with the School of Business joining the UMGC in early 2001. Each of these departments is supporting graduate students conducting research, has created combination teaching and research laboratories, and supported faculty during the summer months.

Derived from text

Students; Sociology; Research; Geology; Anthropology

89

ASTRONOMY

Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.

20030004842 Massachusetts Inst. of Tech., Center for Space Research, Cambridge, MA USA

Target of Opportunity Positioning of Transient X-Ray Pulsars Final Report

Chakrabarty, Deepto, Massachusetts Inst. of Tech., USA; [2003]; 1p; In English

Contract(s)/Grant(s): NAG5-7517

Report No.(s): MIT-6707200; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Our program successfully localized three newly-identified transient X-ray pulsars. XTE J1858+034 is a 221 s pulsar (Takeshima et al. 1998, IAUC 6826), XTE J1946+274 is a 15.8 s pulsar (Takeshima and Chakrabarty 1998, IAUC 7016), and XTE J0111.2-7317 is a 31 s pulsar in the Small Magellanic Cloud (Chakrabarty et al. 1998, IAUC 7048). This last pulsar was a particularly interesting source, and our XTE observations enabled prompt follow-up observations with the ASCA mission (Yokogawa et al. 2000, ApJ. 539, 191).

Author

X Rays; Pulsars; Targets; Positioning

20030004844 Smithsonian Astrophysical Observatory, Cambridge, MA USA

Study of Extra-Solar Planets with the Advanced Fiber Optic Echelle Final Report, 1 Jun. 1998 - 28 Feb. 2002

Noyes, Robert W., Smithsonian Astrophysical Observatory, USA; December 2002; 4p; In English

Contract(s)/Grant(s): NAG5-7505; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This is the final report of NASA Grant NAG5-7505, for 'Study of Extra-solar Planets with the Advanced Fiber Optic Echelle'. This program was funded in response to our proposal submitted under NASA NRA 97-OSS-06, with a total period of performance from June 1, 1998 through Feb 28 2002. Principal Investigator is Robert W. Noyes; co-Investigators are Sylvain G. Korzennik (SAO), Peter Niserison (SAO), and Timothy M. Brown (High Altitude Observatory). Since the start of this program we have carried out more than 30 observing runs, typically of 5 to 7 days duration. We obtained a total of around 2000 USable observations of about 150 stars, where a typical observation consists of 3 exposures of 10 minutes each. Using this data base we detected the two additional planetary companions to the star Upsilon Andromedae. This detection was made independently of, and essentially simultaneously with, a similar detection by the Berkeley group (Marcy et al): the fact that two data sets were completely independent and gave essentially the same orbital parameters for this three-planet system gave a strong confirmation of this important result. We also extended our previous detection of the planet orbiting Rho Coronae Borealis to get a better determination of its orbital eccentricity: $e=0.13 \pm 0.05$. We detected a new planet in orbit around the star HD 89744, with orbital period 256 days, semi-major axis 0.88 AU, eccentricity 0.70, and minimum mass $m \sin i = 7.2 m(\text{sub Jup})$. This discovery is significant because of the very high orbital eccentricity, and also because HD 89744 has both high metallicity [Fe/H] and at the same time a low [C/Fe] abundance ratio.

Author

Extrasolar Planets; Spaceborne Telescopes; Astronomical Observatories; Radial Velocity; Fiber Optics

20030005286 Gemini Observatory, USA

Gemini Observatory Newsletter, No. 25

December 2002; 32p; In English; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This biannual newsletter, the December, 2002 newsletter of Gemini Observatory, covers the dedication of the Frederick C. Gillett Gemini Telescope, and contains a biography of the late infrared astronomer Frederick C. Gillett. Other sections in the newsletter cover recent scientific research at the observatory, including research into stellar populations, Titan's clouds, stellar evolution, the Altair adaptive optics system, the Galactic Center Workshop, a visit by the Duke of York, safety at Gemini Observatory, the observatory's new Internet link, and instruments contributed by countries participating in the observatory.

CASI

Astronomical Observatories; Scientists; Biography; Infrared Astronomy

20030005516 Naval Research Lab., Washington, DC USA

Opening a New Window on the Universe: High-Resolution, Long-Wavelength Radio Astronomy

Kassim, Namir E.; Lazio, T. J.; Erickson, William C.; Nov. 25, 2002; 56p; In English; Original contains color images

Report No.(s): AD-A408473; NRL/FR/7213--02-9957; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Although Jansky's (1933) discovery of radio astronomy was at decametric wavelengths, the urgent quest for ever higher angular resolution and the fact that ionospheric structure limits interferometric imaging to short (less than 5 km) baselines at long wavelengths (LW, taken to be 20 m or 15 to 150 MHz) has left the LW region among the most poorly explored in the entire spectrum.

DTIC

Radio Astronomy; High Resolution

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ASTROPHYSICS

Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.

20030004846 Massachusetts Inst. of Tech., Center for Space Research, Cambridge, MA USA

Simultaneous X-Ray/Ultraviolet Timing of 4U 1626-67 Final Report

Chakrabarty, Deepto, Massachusetts Inst. of Tech., USA; [2003]; 1p; In English

Contract(s)/Grant(s): NAG5-7328

Report No.(s): MIT-6779700; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The science results from our observation have been published (Chakrabarty et al. 2001, ApJ, 562, 985). We detected large-amplitude 0.3- 1.2 mHz quasi-periodic oscillations (QPOs) from the low-mass X-ray binary pulsar 4U 1626--67, using ultraviolet photometry from the Hubble Space Telescope and ground-based optical photometry. These 1 mHz QPOs, which have coherence ($\nu/\Delta\nu$) = 8, are entirely distinct from the 130 mHz pulsar spin frequency, a previously known 48 mHz QPO, and the 42 min binary period (independently confirmed here). Unlike the 48 mHz and 130 mHz oscillations which are present in both the optical/UV and the X-ray emission, the 1 mHz QPOs are not detected in simultaneous observations with the X-Ray Timing Explorer. The rms amplitude of the mHz QPO decreases from 15% in the far UV to 3% in the optical, while the upper limit on a corresponding X-ray QPO is as low as 0.8%. We suggest that the mHz oscillations are due to warping of the inner accretion disk. We also report the detection of coherent upper and lower sidebands of the 130 mHz optical pulsations, with unequal amplitude and a spacing of 1.93 mHz around the main pulsation. The origin of these sidebands remains unclear.

Author

Ultraviolet Photometry; X Ray Timing Explorer; Oscillations; Optical Measurement

20030004849 NASA Ames Research Center, Moffett Field, CA USA

Kepler Mission: A Wide-FOV Photometer Designed to Determine the Frequency of Earth-Size and Larger Planets Around Solar-like stars

Borucki, William, NASA Ames Research Center, USA; Koch, David, NASA Ames Research Center, USA; Lissauer, Jack, NASA Ames Research Center, USA; Basri, Gibor, California Univ., USA; Caldwell, John, York Univ., Canada; Cochran, William, Texas Univ., USA; Dunham, Edward W., Lowell Observatory, USA; Gilliland, Ronald, Space Telescope Science Inst., USA; Jenkins, Jon M., Search for Extraterrestrial Intelligence Inst., USA; Caldwell, Douglas, Search for Extraterrestrial Intelligence Inst., USA; [2002]; 1p; In English; SPIE Meeting/Astronomical Telescopes and Instrumentation, 22-28 Aug. 2002, Waikoloa, HI, USA;

Sponsored by International Society for Optical Engineering, USA

Contract(s)/Grant(s): RTOP 997-24-00; No Copyright; Avail: Issuing Activity; Abstract Only

The first step in discovering the extent of life in our galaxy is to determine the number of terrestrial planets in the habitable zone (HZ). The Kepler Mission is designed around a 0.95 m aperture Schmidt-type telescope with an array of 42 CCDs designed to continuously monitor the brightness of 100,000 solar-like stars to detect the transits of Earth-size and larger planets. The photometer is scheduled to be launched into heliocentric orbit in 2007. Measurements of the depth and repetition time of transits provide the size of the planet relative to the star and its orbital period. When combined with ground-based spectroscopy of these stars to fix the stellar parameters, the true planet radius and orbit scale, hence the position relative to the HZ are determined. These spectra are also used to discover the relationships between the characteristics of planets and the stars they orbit. In particular, the association of planet size and occurrence frequency with stellar mass and metallicity will be investigated. At the end of the four year mission, hundreds of terrestrial planets should be discovered in and near the HZ of their stars if such planets are common. A null result would imply that terrestrial planets in the HZ occur in less than 1% of the stars and that life might be quite rare. Based on the results of the current doppler-velocity discoveries, detection of a thousand and giant planets is expected. Information on their albedos and densities of those giants showing transits will be obtained.

Author

Gas Giant Planets; Photometers; Terrestrial Planets; Stellar Mass; Solar Orbits; Frequencies

20030005550 Colorado Univ., Lab. for Atmospheric and Space Physics, Boulder, CO USA

Microgravity Impact Experiments: The Prime Campaign on the NASA KC-135

Colwell, Joshua E., Colorado Univ., USA; Sture, Stein, Colorado Univ., USA; Lemos, Andreas R., Colorado Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference: Exposition Topical Areas 1-6; November 2002; Volume 2, pp. 143-137; In English; Also announced as 20030005526; Original contains color illustrations; No Copyright; Avail: CASI; A03, Hardcopy; A06, Microfiche

Low velocity collisions (v less than 100 m/s) occur in a number of astrophysical contexts, including planetary rings, protoplanetary disks, the Kuiper belt of comets, and in secondary cratering events on asteroids and planetary satellites. In most of these situations the surface gravity of the target is less than a few per cent of 1 g. Asteroids and planetary satellites are observed to have a regolith consisting of loose, unconsolidated material. Planetary ring particles likely are also coated with dust based on observations of dust within ring systems. The formation of planetesimals in protoplanetary disks begins with the accretion of dust particles. The response of the surface dust layer to collisions in the near absence of gravity is necessary for understanding the evolution of these systems. The Collisions Into Dust Experiment (COLLIDE) performs six impact experiments into simulated regolith in microgravity conditions on the space shuttle. The parameter space to be explored is quite large, including effects such as impactor mass and velocity, impact angle, target porosity, size distribution, and particle shape. We have developed an experiment, the Physics of Regolith Impacts in Microgravity Experiment (PRIME), that is analogous to COLLIDE that is optimized for flight on the NASA KC-135 reduced gravity aircraft. The KC-135 environment provides the advantage of more rapid turnover between experiments, allowing a broader range of parameters to be studied quickly, and more room for the experiment so that more impact experiments can be performed each flight. The acceleration environment of the KC-135 is not as stable and minimal as on the space shuttle, and this requires impact velocities to be higher than the minimum achievable with COLLIDE. The experiment consists of an evacuated PRIME Impact Chamber (PIC) with an aluminum base plate and acrylic sides and top. A target tray, launcher, and mirror mount to the base plate. The launcher may be positioned to allow for impacts at angles of 30, 45, 60, and 90 degrees with respect to the target surface. The target material is contained in a 10 cm by 10 cm by 2 cm tray with a rotating door that is opened via a mechanical feed-through on the base plate. A spring-loaded inner door provides uniform compression on the target material prior to operation of the experiment to keep the material from settling or locking up during vibrations prior to the experiment. Data is recorded with the NASA high speed video camera. Frame rates are selected according to the impact parameters. The direct camera view is orthogonal to the projectile line of motion, and the mirrors within the PIC provide a view normal to the target surface. The spring-loaded launchers allow for projectile speeds between 10 cm/s and 500 cm/s with a variety of impactor sizes and densities. On each flight 8 PICs will be used, each one with a different set of impact parameters. Additional information is included in the original extended abstract.

Author

Microgravity; Impact Tests; Low Speed; Projectiles

20030005861 Smithsonian Astrophysical Observatory, Cambridge, MA USA

Infrared Spectroscopy of Star Formation in Galactic and Extragalactic Regions Annual Report, 1 Mar. 2002 - 28 Feb. 2003

Smith, Howard A., Smithsonian Astrophysical Observatory, USA; January 2003; 106p; In English
Contract(s)/Grant(s): NAG5-10659; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In this program we proposed to perform a series of spectroscopic studies, including data analysis and modeling, of star formation regions using an ensemble of archival space-based data from the Infrared Space Observatory's Long Wavelength Spectrometer and Short Wavelength Spectrometer, and to take advantage of other spectroscopic databases including the first results from SIRTf. Our emphasis has been on star formation in external, bright IR galaxies, but other areas of research have included young, low or high mass pre-main sequence stars in star formation regions, and the galactic center. The OH lines in the far infrared were proposed as one key focus of this inquiry, because the Principal Investigator (H. Smith) had a full set of OH IR lines from ISO observations. It was planned that during the proposed 2-1/2 year timeframe of the proposal other data (including perhaps from SIRTf) would become available, and we intended to be responsive to these and other such spectroscopic data sets. The program has the following goals: 1) Refine the data analysis of ISO observations to obtain deeper and better SNR results on selected sources. The ISO data itself underwent pipeline 10 reductions in early 2001, and the more 'hands-on' data reduction packages have been released. The ISO Fabry-Perot database is particularly sensitive to noise and can have slight calibration errors, and improvements are anticipated. We plan to build on these deep analysis tools and contribute to their development. Model the atomic and molecular line shapes, in particular the OH lines, using revised monte-carlo techniques developed by the Submillimeter Wave Astronomy Satellite (SWAS) team at the Center for Astrophysics. 2) 3) Use newly acquired space-based SIRTf or SOFIA spectroscopic data as they become available, and contribute to these observing programs as appropriate. 4) Attend scientific meetings and workshops. 5) E&PO activities, especially as related to infrared astrophysics and/or spectroscopy.

Author

Infrared Spectroscopy; Infrared Astronomy; Star Formation; Data Bases; Data Reduction

20030006123 Smithsonian Astrophysical Observatory, Cambridge, MA USA

Structure, Motion, and Evolution of Star-Forming Dense Cores *Final Report, 1 Oct. 1998 - 30 Sep. 2002*

Myers, Philip C., NASA Goddard Space Flight Center, USA; January 2003; 10p; In English

Contract(s)/Grant(s): NAG5-6266; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have pursued spectral-line observations of star-forming regions over size scales from 0.01 pc to 0.5 pc. Our main goal has been to measure the systematic and turbulent motions of condensing and collapsing gas.

Derived from text

Star Formation; Stellar Cores; Condensing; Gases; Stellar Structure; Astrophysics

20030006463 Smithsonian Astrophysical Observatory, Cambridge, MA USA

Origin of Outer Solar System *Final Report, 1 Jun. 2000 - 31 Aug. 2002*

Holman, Matthew J., Smithsonian Astrophysical Observatory, USA; January 2003; 7p; In English

Contract(s)/Grant(s): NAG5-9678; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We feel that at the present moment the available theoretical models of the Kuiper belt are still in advance of the data, and thus our main task has been to conduct observational work guided by theoretical motivations. Our efforts over the past year can be divided into four categories: A) Wide-field Searches for Kuiper Belt Objects; B) Pencil-beam Searches for Kuiper Belt Objects; C) Wide-field Searches for Moons of the Outer Planets; D) Pencil-beam Searches for Faint Uranian and Neptunian Moons; E) Recovery Observations. As of April 2002, we have conducted several searches for Kuiper belt objects using large-format mosaic CCD camera on 4-meter class telescopes. In May 1999, we used the Kitt Peak 4-meter with the NOAO Mosaic camera we attempted a search for KBOs at a range of ecliptic latitudes. In addition to our wide-field searches, we have conducted three 'pencil-beam' searches in the past year. In a pencil-beam search we take repeated integrations of the same field throughout a night. After preprocessing the resulting images we shift and recombine them along a range of rates and directions consistent with the motion of KBOs. Stationary objects then smear out, while objects moving at near the shift rate appear as point sources. In addition to our searches for Kuiper belt objects, we are completing the inventory of the outer solar system by search for faint satellites of the outer planets. In August 2001 we conducted pencil beam searches for faint Uranian and Neptunian satellites at CFHT and CTIO. These searches resulted in the discovery of two Neptunian and four Uranian satellite candidates. The discovery of Kuiper belt objects and outer planet satellites is of little use if the discoveries are not followed by systematic, repeated astrometric observations that permit reliable estimates of their orbits.

Derived from text

Gas Giant Planets; Natural Satellites; Kuiper Belt; Inventories; Solar System

20030006468 Smithsonian Astrophysical Observatory, Cambridge, MA USA

VLA Imaging of Protoplanetary Environments *Annual Report, 1 Feb. 2002 - 31 Jan. 2003*

Wilner, David J., Smithsonian Astrophysical Observatory, USA; January 2003; 6p; In English

Contract(s)/Grant(s): NAG5-8195; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Our program uses the techniques of millimeter interferometry to make high resolution observations of dust continuum emission to study the structure of protoplanetary disks around nearby stars. We continue to use the Very Large Array (VLA) of the National Radio Astronomy Observatories (NRAO) to make produce high angular resolution images, and we are improving our capabilities to interpret these observations with detailed numerical models. We have also made the first millimeter interferometer observations of protoplanetary disks in the southern hemisphere, using the recently upgraded Australia Telescope Compact Array (ATCA), taking advantage of the techniques we have developed in our work on northern sources.

Derived from text

Imaging Techniques; Very Large Array (VLA); Protoplanets; Microwave Interferometers; Astrophysics

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LUNAR AND PLANETARY SCIENCE AND EXPLORATION

Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.

20030005110 Smithsonian Astrophysical Observatory, Cambridge, MA USA

Formation of Brown Dwarfs LTSA 2001 Annual Report, 1 Mar. 2002 - 28 Feb. 2003

Luhman, Kevin L., Smithsonian Astrophysical Observatory, USA; December 2002; 3p; In English

Contract(s)/Grant(s): NAG5-11627

Report No.(s): Rept-1; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The goals of the work funded by this grant are: (1) The measurement of the mass function and minimum mass of free-floating brown dwarfs down to the mass of Jupiter; (2) The measurement of the frequency of wide brown dwarf and planetary companions down to the mass of Jupiter as function of primary mass (0.02-2 Msun), age (1-10 Myr), and environment (clusters vs. dispersed regions). For the first objective, we have completed the design of guaranteed SIRTf observations of nearby star-forming regions and now await the launch of the mission in April 2003. In support of these upcoming observations, in the fall of 2002 we obtained optical spectroscopy at the MMT and the 1.5-meter telescope at Fred Lawrence Whipple Observatory for candidate young low-mass stars and brown dwarfs in the IC348 and Taurus star-forming regions. Two papers that include these data in new measurements of the mass functions in these regions are near completion and will be submitted for publication to the Astrophysical Journal in January. We have also proposed deep optical and near-IR imaging of the SIRTf fields in the IC348, Chamaeleon, and Ophiuchus star-forming regions with the MMT, Magellan, and Gemini North telescopes in early 2003. For the second objective, we have used deep HST WFPC2 images to search for young giant planets and brown dwarfs around approximately 100 low-mass stars and brown dwarfs in the nearby cluster IC 348. We have completed all data reduction and have checked these data for candidate companions. We are in the process of writing a paper that describes these candidate companions and presents the companion detection limits that were achieved with HST. We will attempt followup spectroscopy of the most promising candidate companions to confirm their nature as cool companions rather than background field stars during the commissioning of the facility adaptive optics system for the Gemini North telescope early in 2003. In addition, in SIRTf guaranteed time observations we plan to search for wide substellar companions (greater than 10 inches) around the youngest nearby field stars (ages of 30-100 Myr, d less than 30 pc). We have proposed to use Keck adaptive optics imaging to search these same stars for close-in planets and brown dwarfs at 0.1-10 inches, which will perfectly complement our SIRTf observations.

Author

Brown Dwarf Stars; Near Infrared Radiation; Frequency Measurement; Extrasolar Planets

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GENERAL

Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.

20030004734 Massachusetts Inst. of Tech., Center for Space Research, Cambridge, MA USA

XMM Observation of Black-Hole X-Ray Binaries in Outburst Final Report

[2003]; 1p; In English

Contract(s)/Grant(s): NAG5-10192; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This project has been completed. The data have been fully analyzed and published. Publications that evolved from this program, either directly or indirectly, are listed.

Author

Black Holes (Astronomy); X Ray Binaries

20030004838 Massachusetts Inst. of Tech., Center for Space Research, Cambridge, MA USA

Accreting Black Holes an All Out Effort Final Report, Period ending 14 Dec. 2003

Jan. 02, 2003; 3p; In English

Contract(s)/Grant(s): NAG5-3558

Report No.(s): MIT-6529200; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This final report lists many publications resulting from this grant. The following is a representative listing of several dozen title: (1) '1100 Days of BATSE observations of Cyg X-1', D Crary, C. Kouveliotou, J. van Paradijs, F. v.d. Hooft, B. Rubin, S. Zhang, W. Paciesas, M. Fini:er, B. Harmon, M. v.d. Klis, W.H.G. Lewin, and J. Norris, *Astron. Astrophys. Suppl.*, 120, 153-156, (1997) (2) 'Spectral and Temporal Variability in the X-ray Flux' . of GS1124-683, Nova Muscae 1991", M. Takizawa, T. Dotani, K. Mitsuda, E. Matsuba, M. O;;awa, T. Aoki, K. Asai, K. Ebisawa, K. Makishima, S. Miyamoto, S . Iga, B. Vaughan, R. Rc.tledge, & W. Lewin, *Astrophys. J.*, 489, 272, (1997).

CASI

Black Holes (Astronomy); Bibliographies; Deposition

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